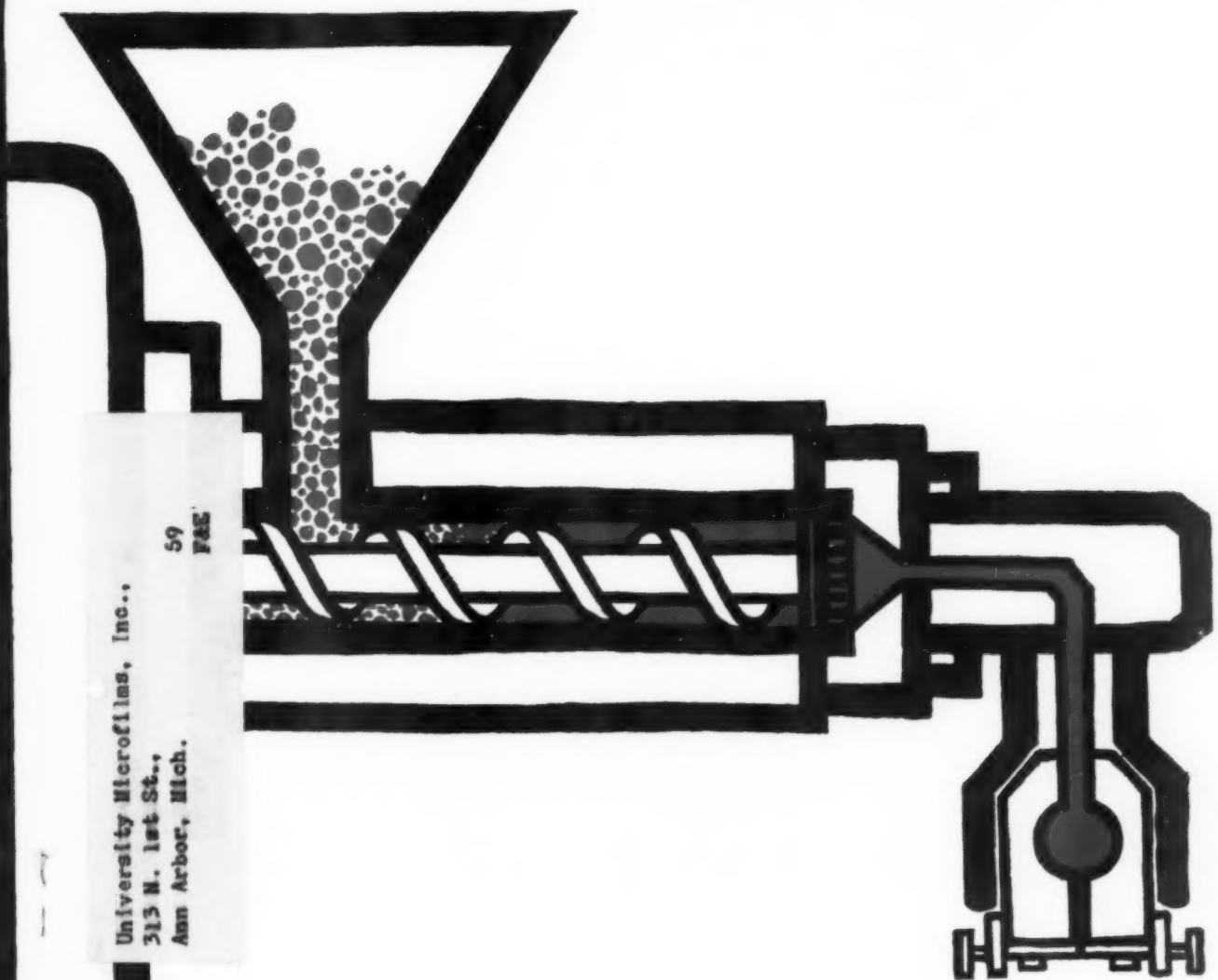
PLASTICS

SEPTEMBER 1960

THE MAGAZINE OF APPLIED ENGINEERING

TECHNOLOGY



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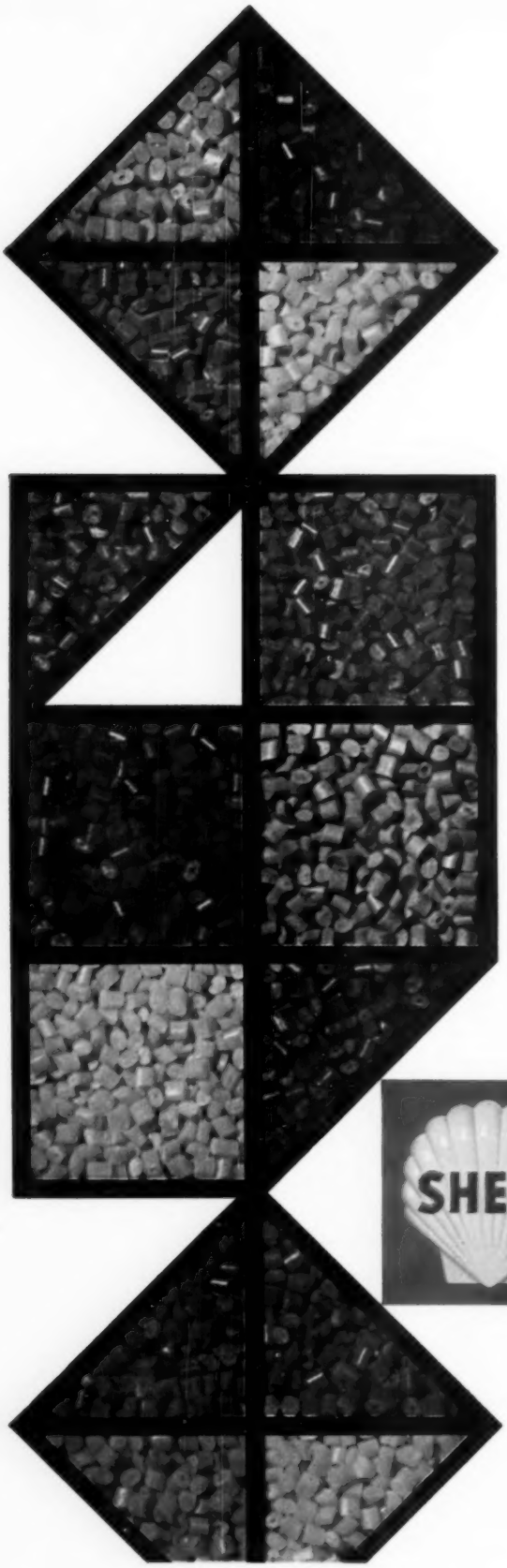
P&E

1960 EXTRUSION AND BLOW MOLDING ISSUE



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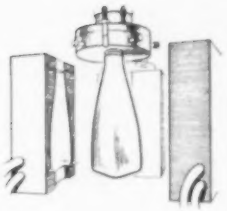

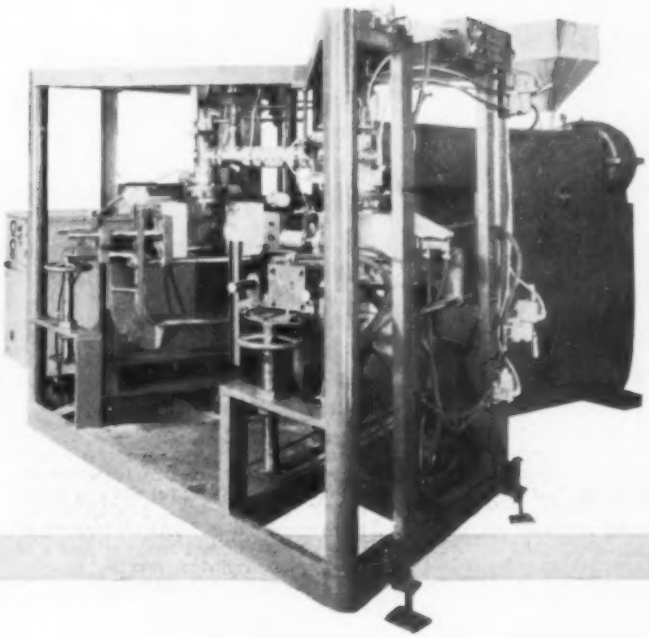

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The "Diversamatic" can be used with *any* extruder, domestic or foreign. If you wish, MPM will provide the *complete* unit, including extruder (see photo at right). Moreover, MPM will operate the unit for your inspection *prior* to shipment, then help you put it into operation in your plant.

In addition to the "Diversamatic," MPM manufactures a one-station, two-head machine, two-station machines with either four or eight heads, and a new six-station *rotary* machine. For information on any or all of these, just drop us a note.

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mpm **Modern Plastic Machinery Corporation**

General offices and engineering laboratories: 64 Lakeview Avenue, Clifton, N. J.

PLASTICS

THE MAGAZINE OF APPLIED ENGINEERING

TECHNOLOGY

September 1960, Vol. 6, No. 9

feature articles:

fixed-orifice pressure control for extruders ..... p. 41

by N. H. MADDOCK

A simple, rapid, and inexpensive method using fixed orifices is described to determine whether the addition of a valve on an existing extruder is desired. The question often is whether the addition of a valve would accomplish sufficient improvement in performance to justify the engineering and construction costs involved. In some cases, the fixed orifice itself has proved to be a complete solution, eliminating the need for a more versatile, adjustable extruder valve.

determining unit costs in the molding plant ..... p. 45

by D. A. DEARLE

In a molding plant, a continuing watch must be kept not only on the quality of parts produced, but also on the actual cost of the parts. Since over-head costs are keyed to direct labor, a watchful eye on labor costs will keep management informed on production efficiency and, therefore, profits or losses incurred. A simple method for recording these statistics is described and evaluated.

tensile-impact measurements on reinforced plastics ..... p. 47

by R. H. CALDERWOOD and A. J. BUSH

A practical tensile-impact test for glass-reinforced plastics is described in detail, together with the testing equipment needed, specimen shape and preparation, and the results obtained. The test uses a larger cross-sectional specimen than was previously suggested. Test results show that greater differences between materials and reinforcements can be picked up than by standard impact tests. These results also show that speed of loading is a critical factor. The need for using different scale ranges and pendulum masses is important to achieve necessary, desirable test results.

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viewing pt's extruder specifications ..... p. 53

by L. J. ZUKOR

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(Based on data submitted by the machine manufacturers)

blow molding processes ..... p. 61

by T. C. BROADWELL

pt's comparative data on 1960 blow-molding machines ..... p. 63

(Based on data submitted by the machine manufacturers)

pt's classified list of auxiliary equipment for extrusion and blow molding ..... p. 66

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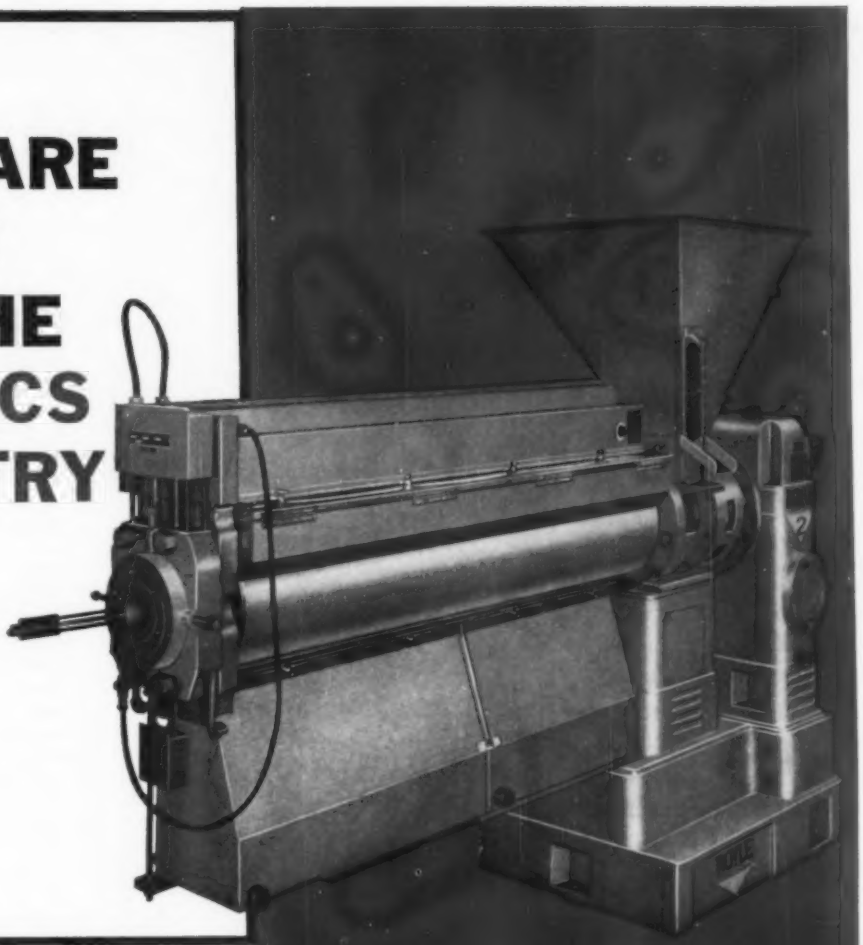

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Letters to the Editor

So We're Not Perfect

Dear Sirs:

We have your May issue and note of all the Conveyor Manufacturers listed under "PT's Classified List of Auxiliary Equipment for Injection Molding" you left out of this list. May we ask why?

A. J. Weiss, Pres.
Brady Conveyors Corp.
Skokie, Ill.

(We're very sorry to have omitted this company from the Classified List. It won't happen again. Brady will be included under Conveyors in the next classified list of extrusion.—Editor)

Words Make All The Difference

Dear Sirs:

I was a little disappointed to see the way in which the answer to Question 3 in the Consultant's Column on adhesives in the August 1960 issue had been handled. Admittedly the answer follows the general idea of adhesives, but it is an accepted fact that it is almost impossible to bond polyethylene with adhesives in the usual sense of the word. Yet, use a filler rod and call it welding, and the problem becomes simplicity itself.

There are objections to the methods suggested in the answer because of the nominated necessity to resist the attack of solvents or chemicals contained in the polyethylene vessel and the fact that a good seal is mandatory.

The success of the first method will depend on the wall thickness of the container and should this be below 3/32-inch, it is doubtful that a continuous seal will result or that, in fact, the wall will be stiff enough to support the tube when it is full of liquid.

The success of this method will further depend upon the amount of specialized equipment available, since the only successful friction welding work carried out in the writer's experience has been done on a special high-speed machine with electron-dynamic braking capable of being brought to a dead stop almost instantaneously. Thus the amount of shear put into the semi-molten bond is the absolute minimum. Shear added in the semi-molten state results in residual stress which will eventually show up as a stress-corrosion area, typical in many plastics; the end result being a failure at the joint, which could be serious if a hazardous chemical is being handled.

The second method is almost doomed to failure from the very fact that polyethylene is burnt in the process. Hence oxidized and carbonized material will find its way into the joint producing serious mechanical and chemical weaknesses.

The problem is by no means insoluble since it is one that the writer has come into contact with several times, and has been successfully overcome by hot-gas welding a polyethylene reinforcing pad to the thin wall container and then welding the tube to the reinforcing pad, the wall and pad having been previously drilled with the correct size hole. The welding was done by local plastic welding contractors who had the necessary dry nitrogen heated torches and usually cost around $5.00. This method is far superior to the others suggested in the articles, since the hot nitrogen protects the partly molten filler rod and therefore eliminates oxidation products with their inherent low chemical resistance and at the same time produces a strong mechanical joint.

Should the enquirer be unable to locate a good plastic welding contractor he has one further alternative. Assuming that the heavy wall pipe is at least Schedule 80, one end can be threaded. Two suitable nuts can be made up and screwed onto the tube on either side of the container wall. When the nuts are tightened together a reasonable seal of a mechanical nature can be expected between the nuts and the wall.

The threads must naturally be a good class 2 fit if sealing is to be expected at that point.

W. H. Henderson, Process Dev. Dept.
Central Laboratories
Electric Reduction Co. of Canada, Ltd.
321 Davenport Rd.
Toronto, Ontario

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identify of the writer will be withheld, if desired.

—The Editor

A Look-In on October

Ethylene Copolymers. J. E. Pritchard, R. J. Martinovich, and P. J. Boeke, Plastics Sales Division, Phillips Chemical Co., Bartlesville, Okla.

Copolymerizing ethylene with 1-butene gives a resin with short-chain branches. This resin has excellent environmental and thermal stress cracking resistance and long-term load bearing ability. Physical properties of various copolymers are given, with special emphasis on the low melt extrusion-grade compound which is used in detergent bottles, wire and cable, fiber and pipe applications.

•

Control of Variables in Heat Resistant Glass Reinforced Plastics. R. H. Sonneborn, A. B. Isham, and F. W. Dennen, Reinforced Plastics Laboratory, Owens-Corning Fiberglas Corp., Granville, O.

This paper summarizes the importance and effect of variables in materials and processing techniques for structural fibrous glass-reinforced plastic panels. Special emphasis is placed on systems employing heat resistant resins.

•

The Hotbench Test Method for Determining the Gelation and Fusion Characteristics of Plastisols. J. A. Greenhoe, plastics division, Monsanto Chemical Co., Springfield, Mass.

The test is reported as a simple and comprehensive means to characterize the changes occurring in plastisols on heating.

•

The Effect of Molding Conditions on the Color of Reinforced Plastics Moldings. T. H. Beals, Paint Division, Pittsburgh Plate Glass Co., Springdale, Pa.

Color in match die molding of reinforced plastics can be affected by pigment concentration, cure time, cure temperature, filler, and resin mixing procedures. A G.E. Spectrophotometer was used to measure color changes.

Engineering Forums for October.

How Close Your Tolerances. Paul Fina, Fiberite Corp., Winona, Minn.

Five Questions and Answers. S. S. Stivala, Consultant.

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. . . unique off-center handles molded with
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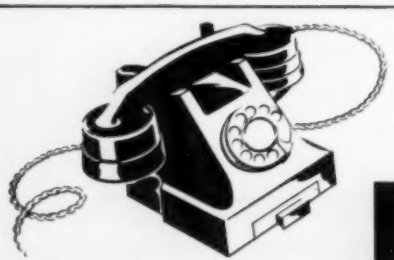

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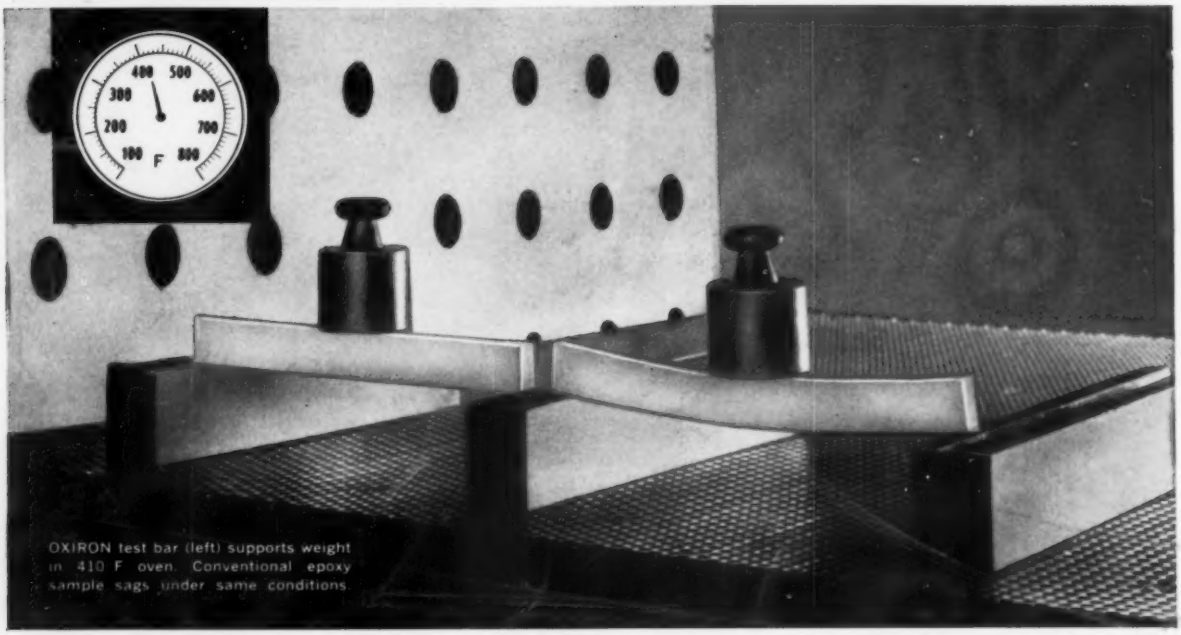


OXIRON test bar (left) supports weight in 410 F oven. Conventional epoxy sample sags under same conditions.

NEW OXIRON EPOXY RESINS OFFER UNUSUAL HIGH TEMPERATURE PROPERTIES

Even after long exposure at elevated temperatures, OXIRON resins have high flex strength and show little weight loss. Anhydride-peroxide-cured OXIRONS resist deformation over a broad range of temperatures. The gentle rise of their heat distortion curves demonstrates why these resins are acceptable for practical use at temperatures far above the heat distortion point (see diagram). In addition to high-temperature strength, OXIRONS have excellent electrical properties which they retain over a wide range of temperatures, show superior resistance to creep at elevated temperatures.

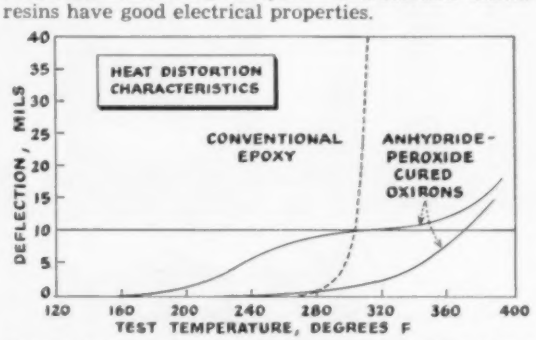
OXIRON resins are unique as epoxies, because they are epoxidized polyolefins rather than bisphenol-epichlorohydrin-type reaction products. Since they provide *10 or more* reaction sites per "monomer" unit, they have a remarkable degree of chemical versatility, as their cure reactions show. The resins are available in a wide range of viscosities and offer an unusual combination of advantages:

Novel Cure: OXIRONS can be cured through their reactive double bonds as well as epoxy and hydroxyl groups. They are the only epoxy resins that can be cured with peroxides. However, conventional epoxy curing agents may also be used. OXIRONS have high reactivity with anhydrides and dibasic acids at low temperatures . . . provide increased pot life with polyamines . . . react with a variety of other curing agents such as polyphenols, Lewis-type catalysts, polysulfides.

Economy: Low-cost curing agents may be used in high proportions.

Low Density: 20% lighter than ordinary epoxies—cured resins likewise have lower density.

Outstanding Chemical and Electrical Resistance: Excellent resistance to alkalis, acids and solvents—cured resins have good electrical properties.



This graph shows that—unlike conventional epoxy resins—the heat distortion curve of OXIRONS does not break sharply with temperatures . . . can be used above the heat distortion point itself.

Send for our Epoxy Data Booklet which describes OXIRON *2000, 2001, and 2002 in detail, contains curing information and gives suggested uses. If you'd like a sample, let us know what application you have in mind so that we can supply a suitable resin.*

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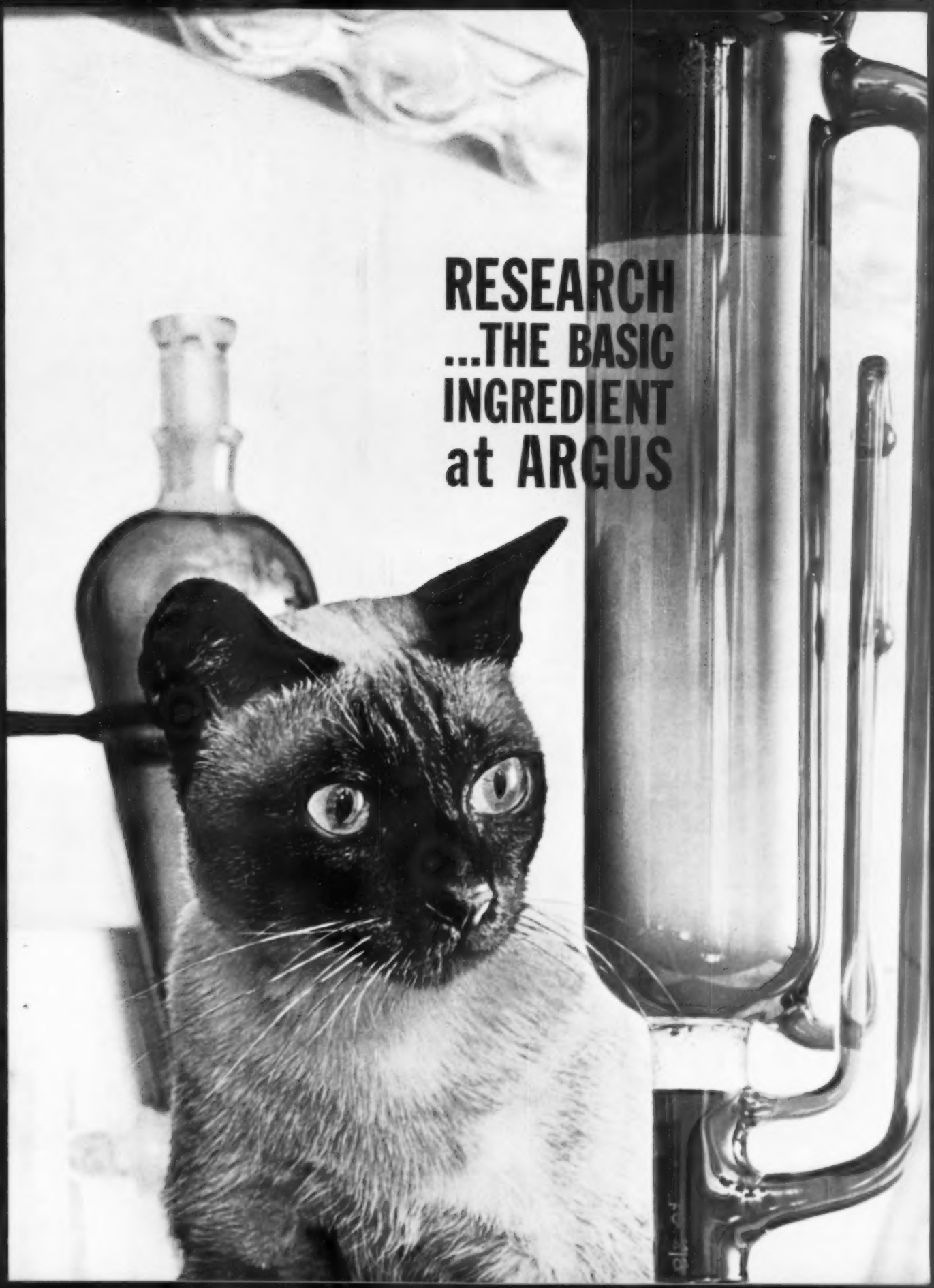
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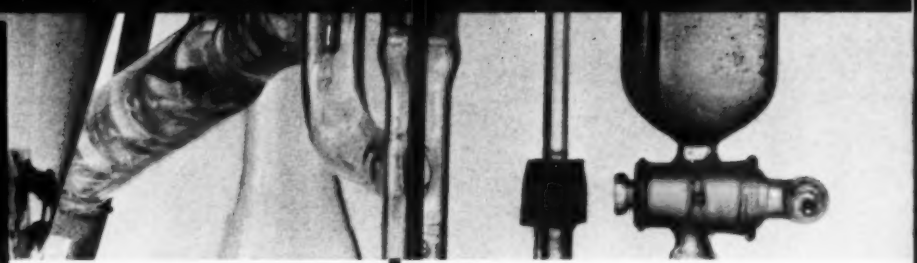

ARGUS MARK STABILIZERS & DRAPEX PLASTICIZERS

Calendered Vinyl	Film
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	Sheeting
	Crystal Clear Rigid PVC
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	Semi-Rigid PVC
	Non-Toxic
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	Opaque
	Electrical Insulation
	Non-Toxic
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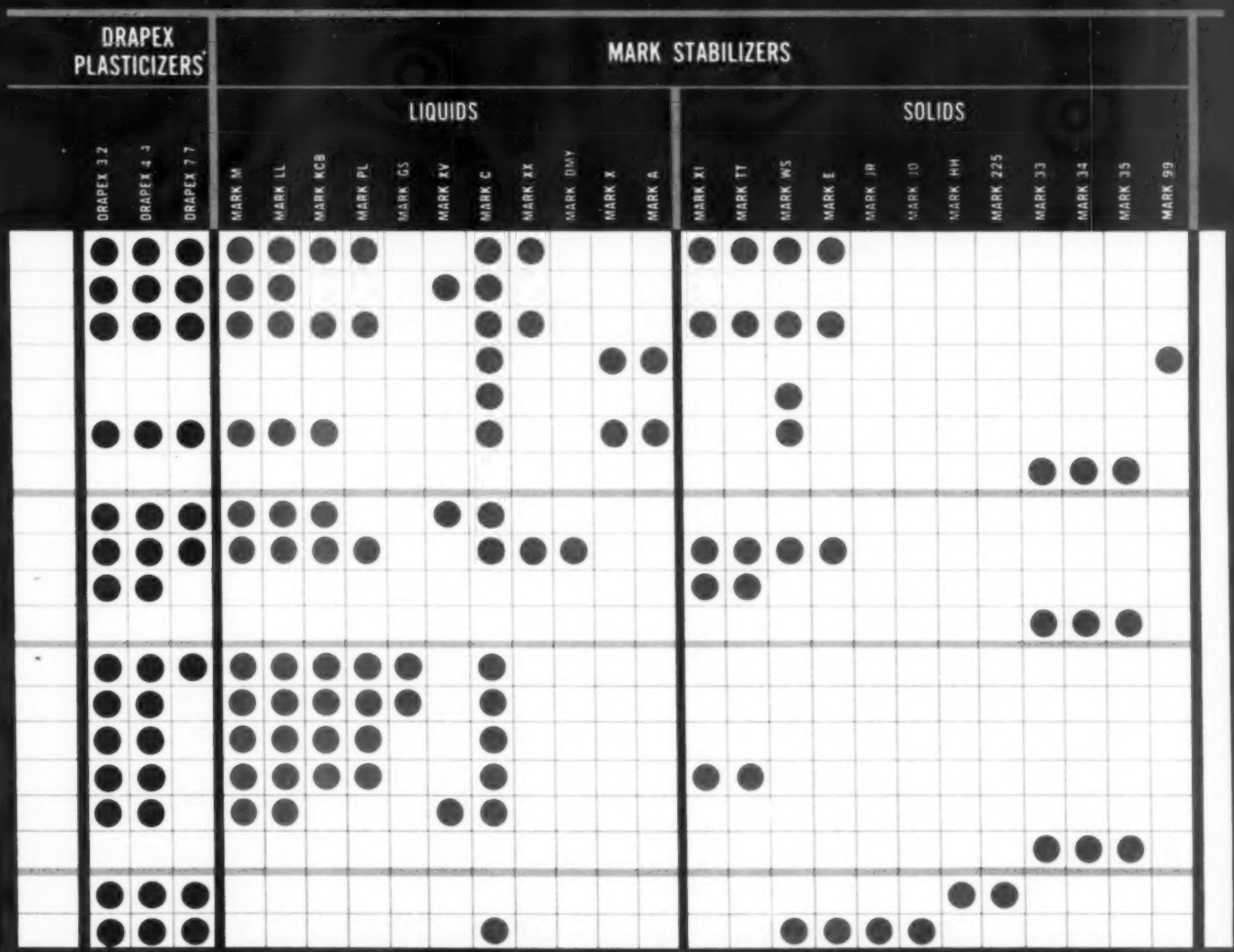

* Drapex 6.8, an epoxy soya, now on stream also.

The characteristics of Argus Mark Stabilizers and Drapex Plasticizers are described on the following page.

MARK STABILIZERS AND DRAPEX PLASTICIZERS

The following information will help you select the right stabilizers and plasticizers for specific needs.

Liquid Stabilizers

MARK M Barium-cadmium complex. Gives outstanding heat and light stability, and excellent initial color. Makes possible high temperature processing without the development of yellow undertones.

MARK LL Newest general purpose barium-cadmium stabilizer. Gives more heat and light stability, and better retention of the true tones of sensitive organic pigments, than any other stabilizer on the market. May be used with all suspension homopolymer resins.

MARK KCB Barium-cadmium-zinc complex. Recommended for resistance to sulfide staining. Also gives outstanding heat stability to all vinyl compounds highly filled with calcium carbonate, regardless of resin choice.

MARK PL Zinc-containing complex. Exhibits a synergistic action on stability and provides high resistance to sulfide staining, when used with other Mark stabilizers.

MARK GS Zinc-containing complex for plastisols. Provides outstanding air release or "bubble break" characteristics, and complete freedom from mold plate-out.

MARK XV Cadmium-containing chelating agent. Markedly improves the heat and light stabilizing action of lead, barium, calcium and strontium stabilizers. Recommended as sole stabilizer for applications requiring light stability and crystal clarity.

MARK C Most efficient chelating agent developed. Used with barium-cadmium systems, it improves heat stability, provides crisper color and superior clarity. Specifically recommended for compounds containing high amounts of phosphate plasticizers.

MARK XX Antioxidant or chelating agent. Increases the efficiency of a saturated metallic soap or a metallic salt.

MARK DMY Chelating agent. Developed specifically for applications requiring extreme long-term stability.

MARK X & MARK A Alkyl tin mercaptides. Specifically recommended for stabilizing crystal-clear unplasticized compounds and certain European emulsion polymerized resins which may be difficult to stabilize with conventional barium-cadmium stabilizers.

MARK XI Coprecipitated barium-cadmium laurate. Provides excellent heat and light stabilization. Also, used with Mark M or LL, it is recommended for stabilizing compounds containing more than five parts of a phosphate plasticizer.

Solid Stabilizers

MARK TT Barium-cadmium soap, generally interchangeable with Mark XI. Recommended for stabilizing high-phosphate formulations as well as all general purpose vinyl applications. Gives excellent heat stability.

MARK WS Barium-cadmium complex. Most powerful stabilizer available. Recommended where an exceptional degree of long-term stability is required.

MARK E Strontium-zinc laurate. Gives complete freedom from sulfide staining. Has a very low degree of toxicity.

MARK JR & MARK JO Barium-zinc complexes for the stabilization of highly filled compounds such as floor tiles, cove moldings, etc. Provide complete freedom from sulfide staining. Non-lubricating, they do not hinder processing.

MARK HH & MARK 225 Stabilizers specifically developed for vinyl asbestos flooring compounds. Give excellent long-term stability and retention of initial color. Non-lubricating, they do not hinder processing.

MARK 33, MARK 34 & MARK 35 New, non-toxic stabilizers. Give stability superior to that of any non-toxic stabilizer previously available. Withstand the high heat needed to process unplasticized vinyl. May be used in rigids as the sole stabilizer system, and give excellent stability. Approved by the Food & Drug Administration. **MARK 33** gives exceptional long-term heat stability. Recommended for pigmented or darker stocks. **MARK 34** is recommended where good initial color is required. Provides good clarity. **MARK 35** gives better initial color than Mark 33, and longer stability than Mark 34.

MARK 99 Barium-cadmium organic complex providing excellent stability and clarity at low cost for clear rigids. Eliminates problems of light stability, cross-staining and offensive odor which are encountered with tin mercaptide systems.

Plasticizers

DRAPEX 3.2 Octyl epoxy stearate. Recommended where the best possible low temperature flexibility is required. Also gives good heat and light stability, lower volatility, and greater resistance to extraction by soaps and detergents.

DRAPEX 4.4 Octyl epoxy stearate. Has a higher epoxy value than Drapex 3.2 and therefore superior heat stabilizing action.

DRAPEX 7.7 High-solvating, primary plasticizer with polymeric properties. Gives outstanding resistance to staining. Gives low volatility and excellent resistance to leaching by water, oil and other extractants.

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Joe Foster, President,
tells why Nylon-6 is one of the
great molding resins.

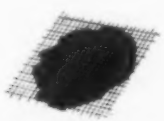
"There are four good reasons why Nylon-6 is one of the great molding resins," *says Joe Foster*

COLORABILITY

Fosta Nylon accepts a wide range of colors. To suit your manufacturing requirements, Fosta Nylon may be pigmented *during* formulation. Or, articles may be colored in water-soluble dyes *after* fabrication.

NON-FLAMMABILITY

Fosta Nylon is one of the few self-extinguishing materials and is ideal for use in portable electric appliance housings. Also, Nylon-6 provides good heat-resistance and good electrical properties.



EASE OF MOLDING

Higher melt viscosity of Fosta Nylon makes it easy to injection mold or extrude. Thick or thin cross-sections and large surface areas may be produced with greater ease than ever before.

STRENGTH

Fosta Nylon will resist severe impact and heavy stresses in all directions, even in thin sections. It has excellent wearing properties due to a low coefficient of friction and is resilient, recovering readily from deformation under load.

IF DESIGN, development or marketing of profitable, efficient end products is your responsibility, you can't afford to overlook Fosta® Nylon's unique combination of advantages as a fabricating material.

One of the great molding resins, Nylon-6 lends itself to a wide-range of end products, including: portable electric appliance housings, drapery hardware, gears and football cleats. And, our customers' experience plus our own work as the world's largest manufacturer of sunglasses indicates there are countless other applications for this resin.

Its basic properties make us confident that versatile Nylon-6 has a wonderfully promising future. In addition to colorability, strength, non-flammability and ease of molding, Fosta Nylon also provides toughness, abrasion- and impact-resistance, flexibility, heat-stability and is self-lubricating. This is why Nylon-6 can do almost anything a molded product may require.

Still another product advantage is the magic name of "Nylon." Consumers everywhere know that a "Nylon" product is something special, is different from any other materials and possesses greater product features. You'll find the extra merchandisability of "Nylon" can add magic sales-power to all types of products.

As an incentive to make Nylon-6 a more widely used material, we recently reduced the price of Fosta Nylon to 98 cents a pound in quantity. Our confidence in Nylon-6 prompted this move.

To make Fosta Nylon more familiar to you, we would like to send you our current literature. Whatever your product design, development and marketing strategy, we'll be glad to demonstrate why Nylon-6 should be part of your thinking. Just call or write Foster Grant Co., Inc., Leominster, Mass., KEystone 4-6511. We're ready to work with you right now!

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This Month in Brief

The lead article this month describes a simple, fast, and inexpensive method of determining whether the addition of a pressure control valve between the extruder screw and the forming die is practical. In some cases, a fixed orifice itself provides the solution and an adjustable extruder valve is not needed.

"Determining Unit Cost in the Molding Plant" points out that quality control without cost control is not enough to cut overhead costs. A simple method is given for recording labor costs and production efficiency.

"Tensile Impact Measurements on Reinforced Plastics" gives a test method which points out greater differences between materials than does the Izod impact test. Testing equipment is described; also specimen shape, preparation, and evaluation of results.

Restating our basic purposes by a back-to-school analogy is a way of describing this month's editorial. We ask that you keep us informed as to our effectiveness and your needs.

The Guest Editorial is by Louis Rahm, and is entitled "Why an American Plastics Institute?" He comes out strongly in favor of the Institute, and associates the idea with maturity in the plastics industry.

Extruders, Blow Molding machines, and auxiliary equipment for both are tabulated this month. Manufacturers' names and addresses are included. This is an annual issue.

"Frequently Asked Questions" is the title of this month's engineering forum on reinforced plastics. Harry Douglas is the regular contributor.

Special features this month: "Blow Molding Processes" by our new Advisory Board member, T. C. Broadwell of Dow Chemical Co.
"Viewing PT's Extruder Specifications" by our engineering editor, L. Zukor.

Exploring Fabrication Techniques describes a method for sealing Teflon around a metal insert by induction heating. The technique was developed at DuPont's Chesnut Run Technical Service Laboratory.

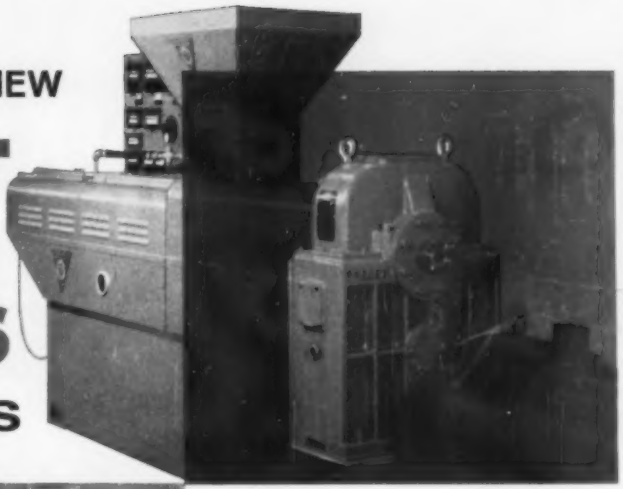
Years Ahead! The VERSATILE, NEW

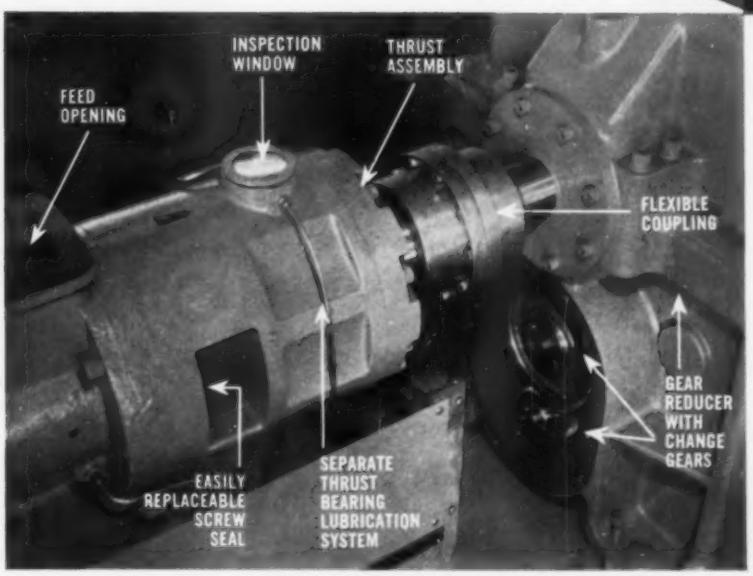
PRODEX HT

HIGH TORQUE

EXTRUDERS

with CHANGE GEARS





BOTH HIGH AND LOW VISCOSITY MATERIALS CAN NOW BE EXTRUDED AT MAXIMUM H.P. EFFICIENCY AND OUTPUT

LOOK AT THESE HORSEPOWER RATINGS	
EXTRUDER SIZE	HORSEPOWER RATINGS
1¾"	7½-10
2½"	20-40
3½"	40-100
4½"	60-150
6"	125-200
8"	200-400

The versatile PRODEX **HT** EXTRUDER gives you the opportunity to quickly select the optimum reduction ratio and screw speed necessary to achieve the highest possible production rate for each extrusion job.

This is now possible because the new PRODEX gear reducer with change gears is capable of transmitting as much torque as the screw can handle. All plastic materials can now be run at maximum output and horsepower efficiency of the motor drive.

Let us show you **all** the new features incorporated in the new PRODEX **HT** EXTRUDER. See it perform with your own materials in our customer service laboratory. Write or phone for appointment.

ONLY PRODEX HAS ALL THESE DESIGN FEATURES

- GEAR REDUCER: Vertical design for space saving and extra ruggedness. Herringbone gears thruout.
- CHANGE GEARS: For selection of the optimum reduction ratio and screw speed at any time.
- SEPARATE THRUST ASSEMBLY permits easy accessibility and maintenance. The spherical roller thrust bearing used in all machines is self aligning.
- SEPARATE THRUST HOUSING LUBRICATION SYSTEM: Oil is continuously circulated by a gear pump through a filter cartridge. Best bearing oil can be used. No compromise between gear and bearing lubricant as in other machines.
- FLEXIBLE COUPLING to absorb thermal expansion misalignment between gear reducer and extruder. Avoids any possible thrust load on gear reducer.
- FULL DIAMETER SCREW SHANK to handle heaviest torque load.
- INSPECTION WINDOW on thrust assembly housing permits visual bearing and oil feed inspection.
- EASILY REPLACEABLE SCREW SEAL to prevent leakage of dusty powders and for use of vacuum hoppers and melt feeds.
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Write for illustrated bulletin E-6.

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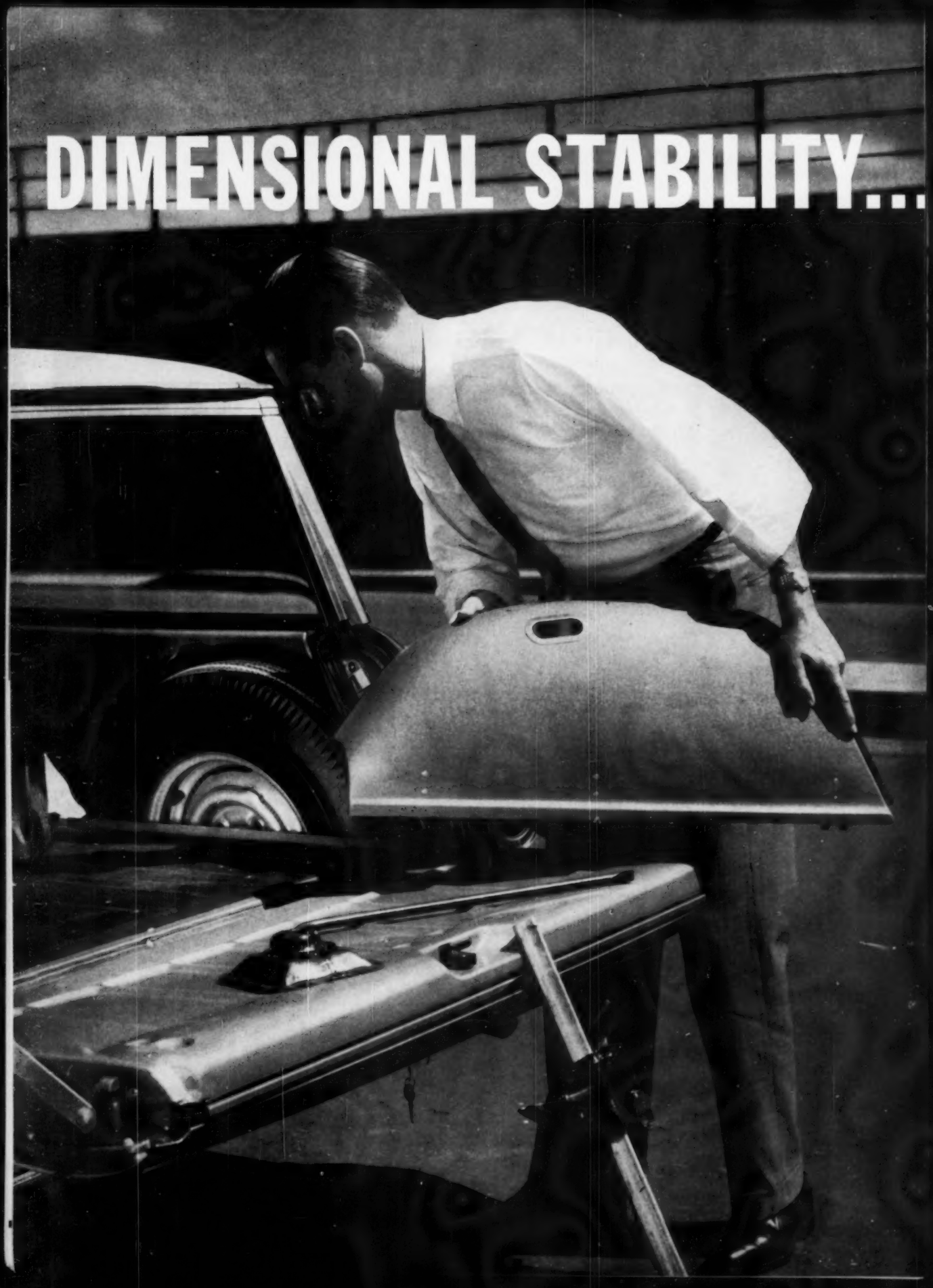
DIMENSIONAL STABILITY...

...another way high-density polyethylene IMPROVES YOUR PRODUCT

TYPICAL PROPERTIES OF DGDA-3451

Properties	ASTM Test	Typical Value
Density, gm/cc	D 1505	0.960
Melt Index, gm/10 min.	D 1238	0.1–0.3
Tensile Strength, psi	D 638	4200
Elongation, %	D 638	60
Secant Modulus, at 1%, psi	D 638	157,000
Hardness, Durometer "D"	D 676	63
Tensile Impact, ft. lbs./ cu. in.		160

Tough, attractive tire cover demonstrates dimensional stability of products made from BAKELITE Brand High-Density Polyethylene. It is manufactured by Woodall Industries, Inc., Detroit, Michigan for Ford Motor Co., Dearborn, Michigan.

THE FORD MOTOR COMPANY'S "Comet" and "Falcon" station wagons are built with some impressive new ideas—combining styling with economy. Even the spare tire gets unusual treatment.

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What's more, this tire cover meets the manufacturer's requirements for attractive appearance. The surface is embossed and the color complements the car's decor. Besides dimensional stability and eye appeal, BAKELITE high-density polyethylene has excellent rigidity, toughness, heat resistance and stress cracking resistance.

Whatever combination of polyethylene properties you need can be found in BAKELITE Brand materials, including low, medium, and high-density polyethylenes. And you can call on the broad experience of Union Carbide in plastics development for help in making your selection. Mail the coupon today, or write a description of your requirements directly to Dept. DP-105, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *In Canada*, Union Carbide Canada Limited, Toronto 12.

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Here is the air cooled extruder that offers more effective cooling than any other comparable model on the market today!

Each cylinder zone on the new Egan Air Cooled Extruder is fitted with a high capacity blower. Air from each blower is channeled through the ductwork and a specially designed chamber for a completely dependable, high-velocity flow along the periphery of the zone. You get maximum uniform cooling!

In addition, the Egan Air Cooled Extruder retains all the time tested and proven features found in Egan's other extruder lines—heavy duty thrust bearings, herringbone gear speed reducers, and a host of other operating and maintenance features.

Whatever your requirement in extruders—air cooled, direct electric heat, or "Willert Temperature Control System"—Egan can meet your every need.

Egan Extruders are available in sizes from 2" through 10" with L/D ratios from 20:1 through 32:1.

FREE—Write for your Egan Extrusion Speed Calculator for film, coating and laminating.

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Monsanto Polyethylene 37 and 38 Resins for extruding films with both clarity and strength

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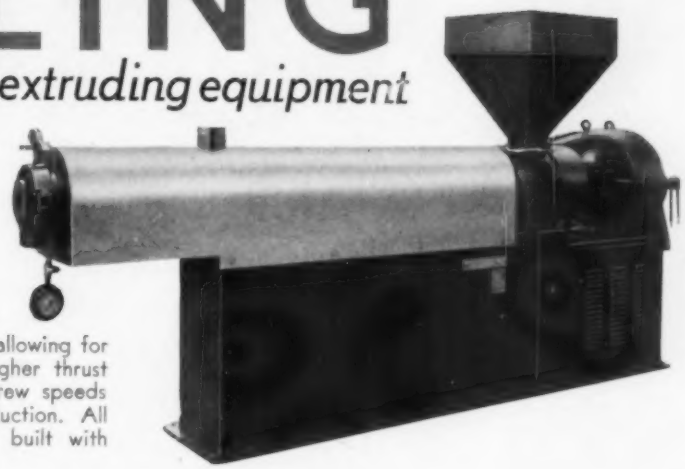

Sterling high speed and high production extruder pictured here incorporates new reducer, new thrust bearing assembly and new lubricating system allowing for higher horsepower input, higher thrust bearing capacity, higher screw speeds and therefore higher production. All Sterling Extruders are now built with these new components.

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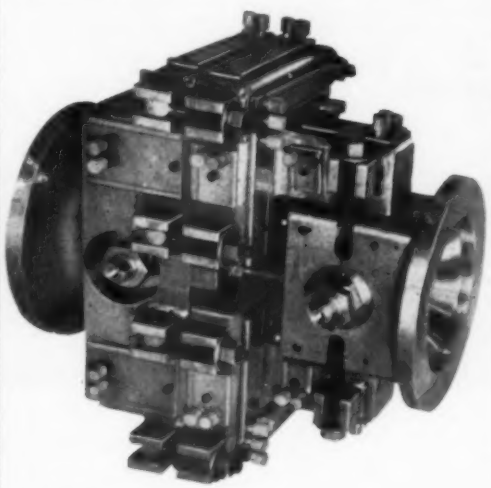

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Blown Tubing Dies, from 1" through 72" diameter of special design, eliminating all weld lines.

Sterling Pelletizer works with Extruders 1½" to 6". Instant synchronization with Extruder is available. Ease of operation, maintenance and cleaning is insured by extremely compact design. Insures excellent uniformity of pellets, clean cutting action — and a considerably lowered noise level.

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Editorial: On School and Students

September, and back-to-school days! What a lot of memories—some good; some, well . . . Since plastics is a relatively young industry, we might draw an analogy between it and the bright young student looking to make his mark in the world.

•

What of us, PLASTICS TECHNOLOGY? What role are we to play—the teacher? If so, it had better be the dedicated type who serves rather than directs, moderates rather than pontificates, and who feels there is much to be learned from his students.

Let's draw the analogy a little further. There are all kinds of students. There's the short-sighted type who is interested primarily in grades—memorize now, forget later. He'd never help a fellow student. There's the careless student who overlooks Part B of the question and, after working out a complicated equation, forgets to check the simple addition. Then there's the copier—anybody know him?

Lastly is the student we would most like to serve. He does best on "open-book" exams. He may not always have the answer at his fingertips, but usually knows where to find it. Always interested in improving himself, he is the doer, the backbone of our industry.

•

How can we best serve him? A very good way would be to plan the curriculum around his expressed needs and interests. We try our best to determine these needs, based on the job classifications of our readers. If we are doing the job, please tell us. If not, by all means please do!

Here are our basic editorial plans for the year: Special equipment issues which can become reference guides to injection, compression, extrusion, forming, and blow molding machinery—plus their accessories; and articles on current processing techniques. Materials and materials testing will be considered from the processing viewpoint.

We do not wish to serve as a textbook! Our aim is timeliness. We ask your assistance in bringing this about. Any and all suggestions will be appreciated.

•

We just received a communication concerning one of the former student types mentioned above. Plastics Age News, Tokyo, September 1 issue reports that the Japanese Ministry of International Trade and Industry feels the technical standard of domestic molding machinery is sufficiently high that import restrictions should be strengthened. I guess they feel they've copied everything there is to learn. While one can oppose economic isolation in principle, such action on their part makes it seem not altogether bad. Reciprocity requires more than one element.

Jim Dugan

Editor

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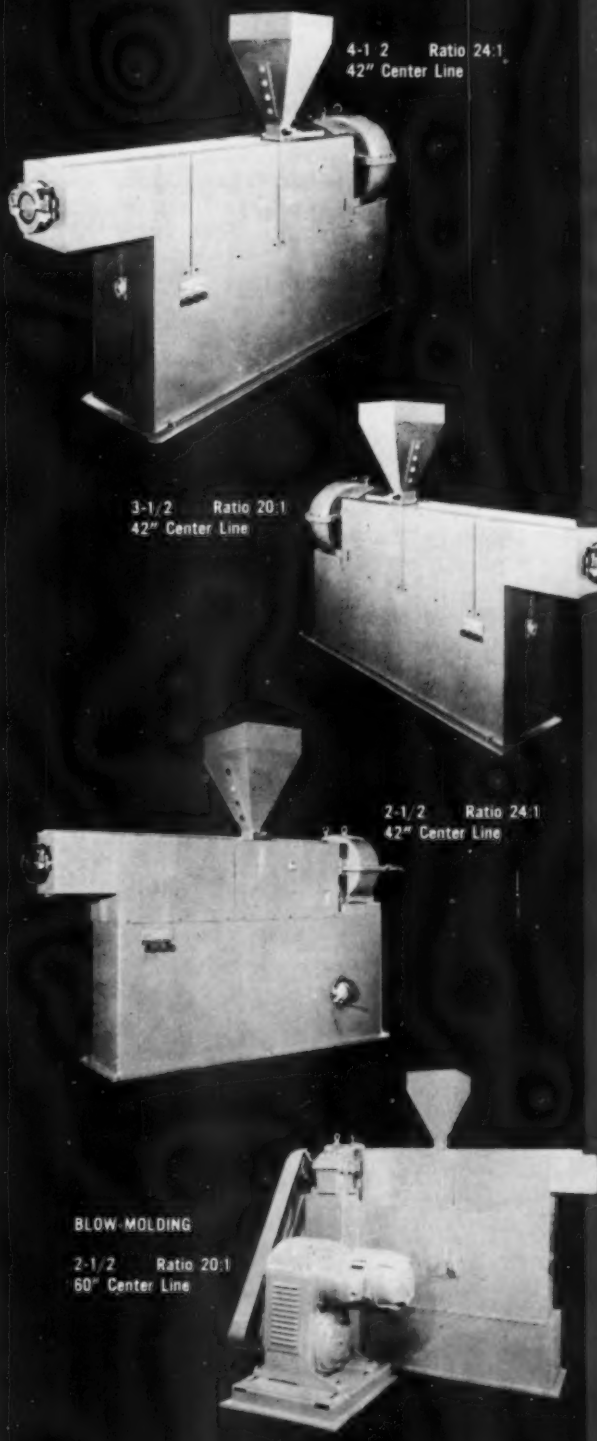

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- Herringbone gear reducer permits maximum power transmission.

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NOTE: *All wiring on the Olympia Extruder is completed at factory.*

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SIZES: 1½, 2½, 3½, 4½, 6

L/D RATIOS: 20:1—24:1

Each Olympia extruder is easily adaptable to your specific application.

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What's new in processing

Radiation Applications, Inc., in conjunction with AEC's Office of Isotopes Development, has launched a comparative study of nuclide and electron radiation for graft polymerization and the development of techniques for reducing the radiation dose requirements for cross-linking plastics by as much as 90%. Comparison of isotope and machine radiation is particularly important since many accelerator manufacturers have criticized AEC for concerning itself solely with nuclide radiation. RAI will use polyethylene and nylon as basic materials, grafting onto four monomers: styrene, styrene acrylonitrile, methyl acrylate, and vinylidene fluoride. Factors to be explored include dose rates, temperatures, monomer and copolymer concentration, and pretreatment of monomer and polymer.

Plastic Associates, Laguna Beach, Calif., has developed a two-step process for joining nylon to metal. An epoxy paste chemically unites with the metal surface and a solvent softens the nylon, allowing it to blend with the epoxy bonding agent as it hardens. The entire operation takes place at room temperature.

An extract of western hemlock bark is used by Rayonier, Inc., Montreal, as a highly reactive polyphenolic intermediate in adhesives for bonding cold-setting laminates. The material is a partial replacement for the more expensive resorcinol, and is said to give a much longer pot life.

Lok-in Label, a product of National Laminating Sales Co., utilizes a cold-seal process for applying a permanent, full-color label to all types of plastic and glass containers. The printed image, acetate faced, is suspended between a special adhesive which seals the printed copy.

Food Machinery & Chemical Corp. has developed a fabric laminating technique for short-run furniture and panelboard production. Patterned fabric is saturated with Dapon diallyl phthalate resin, a clear Dapon-impregnated paper overlay is applied, and a laminating pressure of 100-250 psi. is exerted.

Abstracts

"High-Clarity Blown Polyethylene Film" by J. Pilaro and R. Kremer, Modern Plastics, June, 1960, describes a method for improving the film's optical properties by using a tubular annealing chamber. Positioning and construction details are given, plus its effects on various resins.

"Design Tips for Polyolefin Parts" by J. N. Scott, J. V. Smith, and D. L. Alexander, Modern Plastics, June, 1960, points up the molding defects which may be encountered and suggest how to overcome them through proper mold design.

"A Guide to Winding—Part I" by S. F. Oakes and A. A. Arterton, Modern Plastics, August, 1960, gives the engineering principles and equipment involved in obtaining a properly wound roll of film. Schematic diagrams illustrate text.

"Controlled Density Polystyrene Foam Extrusion" by F. H. Collins, SPE Journal, July, 1960, describes a new process using a hydrocarbon foaming agent to extrude sheet, tubing, and rod.

Patents

2,889,651—production of multi-color three-dimensional plaques by vacuum forming thermoplastic sheet material to provide a low-relief predetermined distortion pattern lying in a single plane, ink rolling it, and vacuum forming it to achieve register.

2,889,581 to Resistoflex Corp.—a method of extruding polytetrafluoroethylene tubing from paste followed by sintering. The extruded tubing is placed within a pipe during oven sintering.

2,892,217—a process for bending plastic sheet comprises folding it, placing it over a heatable support.

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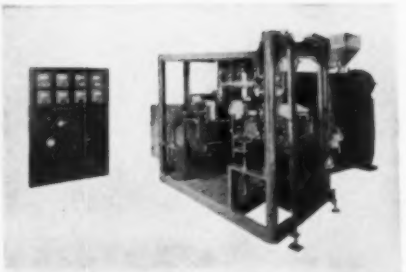

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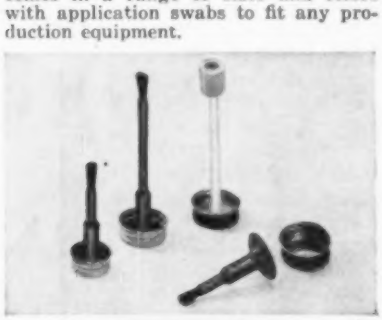
A series of advertisements for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

SEPTEMBER 1960 — U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation — 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

Low-cost contour packaging equipment (below) tight-wraps any shape product with a special formula transparent polyethylene film. Machine's key feature is a heated-air shrink tunnel. No liquid dip is required; there is no appreciable change in product temperature. According to the manufacturer, low cost of equipment and polyethylene film plus reduced handling and labor expenses make this machine ideal for packaging almost any item, even at relatively low production rates.

A one-piece brush and cap for containers of paste, shoe polish, rubber cement and the like employs a polyethylene shank and flange, preassembled to a metal cap, to prevent seepage and evaporation of liquid contents. The molding has a retaining bead which holds the flange firmly against the metal, eliminating the need for riveting or soldering and a washer. Swab is stapled in place. Designed to replace a steel shank and cap, the assembly comes in a range of sizes and colors with application swabs to fit any production equipment.



"Plastics Packaging—Problems, Potentials, Profits" is the theme of a Packaging Institute seminar to be held September 28th at the Statler-Hilton Hotel, New York City. Twenty panelists, including a representative from U.S.I., will participate in the discussion, which will cover all phases of packaging—from resins to end use. For details, write to Packaging Institute, 342 Madison Ave., New York 17, N. Y.

U.S.I. Introduces Two New PETROTHENE Polyethylene Blending Resins

Also Useful for Injection Molding into Items with High Flexibility

U.S.I has developed two new high-melt index PETROTHENE resins ideal for blending with lower flow polyethylene resins for non-critical injection molding applications. The high flow characteristics of these resins can serve to greatly increase the flow of other available resins to meet product and production requirements. These resins are also usable without blending for injection molding of non-critical items where an extremely high degree of flexibility is required.

Artificial flowers such as these can be injection-molded from U.S.I. PETROTHENE 270 polyethylene resin.

PETROTHENE 270 has a melt index of 70 and a density of .912. It is an ideal resin for molding soft items such as artificial flowers. Key properties include *very* high flow rates, *very* high flexibility and excellent low-temperature impact strength in molded items. Because this high flow resin can be molded at an extremely low level of locked-in stresses, it shows excellent low-temperature impact strength according to practical type tests on molded items conducted at U.S.I.'s Polymer Service Laboratories.

In addition to high flexibility and resistance to cracking at low temperatures, products molded from PETROTHENE 116 have high gloss and excellent appearance. This resin can be used to form large non-critical molded items—not as flexible as those made from PETROTHENE 270, but still very flexible. Its density is 0.919, melt index 33.0.

Blending Data Available

U.S.I. has prepared graphs for determining the weight percent of PETROTHENE 270 or PETROTHENE 116 required with any lower-melt index resin to obtain a blend of any desired intermediate melt index.

To obtain these graphs or additional technical data, write Technical Literature Dept., U.S.I., 99 Park Ave., New York 16, N. Y.

Process Improves Bonding Of Polyethylene To Metal

A new process for bonding polyethylene to metal produces unusually strong bonds, limited only by the strength of the plastic itself. The process is ideally suited to copper alloys containing over 85% copper, but the inventors feel it will work with any metal that can be copper plated.

In this process, polyethylene is molded directly to oxide-coated metal. Key to its effectiveness is chemically treating the metal to form a cupric oxide film since neither a cuprous oxide film nor a thermally oxidized surface will form strong bonds. Bond strengths, measured with the conventional Instron machine, are 20 to 40 lbs. per inch of width, in contrast to the best previously attainable strengths of 5 to 10 lbs.

According to the developers, the process will make possible pressure-tight seals between polyethylene and copper in repeater units of submarine cables —long a problem. Out of it, too, may come advances in flexible printed circuits, microwave devices and other electronic equipment where the excellent electrical properties of polyethylene can be utilized. And it may spur wider use of metal-polyethylene panels as structural materials in the construction field.

How to Improve Heat Sealing

A new U.S.I. technical data sheet shows how to solve major problems encountered in heat sealing polyethylene film. Such difficulties as non-uniform seals, weak seals, and film adhesion to the sealing jaw are discussed. For copies of the data sheet, "Improve Heat Sealing by Modifying Equipment," write U.S.I's Technical Literature Dept.

Polyethylene Plus Aggregate Forms New Paving Material

A new paving material compounded of pigmented polyethylene and aggregate promises to bring color-coding of roads and runways closer to reality. It can be mixed and applied (in a one-inch layer) using conventional machinery and methods. Brilliant white test curbing being installed above defines road boundaries. Other possible uses: multi-colored home driveways, tennis courts, sidewalks, swimming pools.

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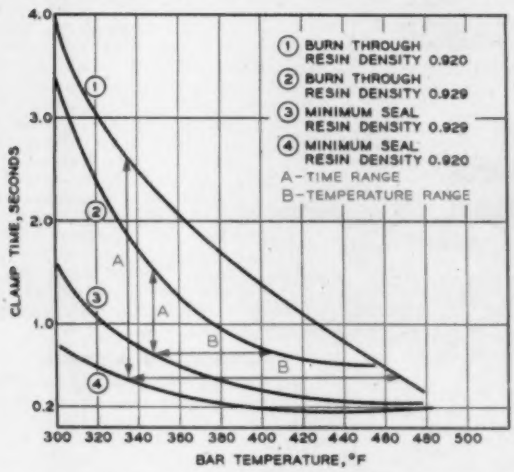
POLYETHYLENE PROCESSING TIPS

MACHINE CHARACTERISTICS AFFECTING HEAT SEALS

Polyethylene film heat seals easily to form air-tight, moisture-proof containers for a wide variety of packaging applications. However, sealing equipment that is poorly designed or improperly used may cause such problems as non-uniform seals, weak seals, or film sticking to sealing jaws.

Many sealers that were adequate when only low-density polyethylene resins were available do not provide the control needed for higher-density, high-clarity films now on the market. The reason, shown graphically below, is that as resin density increases, temperature range between minimum seal and burn-through of film narrows. This range may be narrowed still further by gussets in bags or variations in film gauge.



Increasing density from 0.920 (PETROTHENE® 210) to 0.929 (PETROTHENE 239) results in a narrowing of the heat-seal range between minimum seal and burn-through. (0.5 mil blown tubing)

Temperature Variations

A common cause of poor heat seals is excessive temperature variation along the length of the sealer blade. Best results are obtained when the temperature varies less than 15 degrees F.

With jaw-type sealers, such control may be achieved by replacing or repositioning the heater elements, or if necessary, by replacing the entire sealing jaw. Similar measures work for band-type sealers as well.

It is difficult to measure temperature differences on impulse sealers, but easy to insure desired temperature uniformity. These sealers function by passing an electric current through a wire while it is in contact with the film to be sealed. Temperature differences arise from variations in the diameter of the wire, which offer varying electrical resistances. Hence, regular visual inspections are recommended. When nicks or deformities are found, the wire should be replaced.

Pressure Control

Pressure also must be uniform and accurately controlled across the sealing bar or wire. This is especially true of jaw-type sealers.

Pressure variations may be caused by misalignment of the sealer blade or wire or use of improper backing material. The face of the sealing jaw should be parallel to the backing pad. The preferred backing material is a high-temperature-resistant synthetic material which provides solid backing with just enough resilience to even out small pressure differences.

Most polyethylene seals are made in the 20 psi to 100 psi range. However, many heat sealers in use today were originally designed for materials requiring much higher sealing pressures. It is impossible to control them accurately at lower pressures. To produce consistently good heat seals, such equipment must be modified or replaced.

Serrated Jaws Best

Serrated jaws are preferred to smooth jaws on heat sealers as they eliminate extrusion of the film and resultant weakening of the seal. If smooth jaws cannot be avoided, pressure must be accurately controlled to prevent unnecessarily high pressures and excessive film extrusion.

With some polyethylene resins, film may stick to the jaw, whether serrated or smooth. This can be prevented by installation of a non-sticking membrane between jaw and film or application of a non-sticking jaw.

Match Machine To Use

Impulse sealers are recommended for most in-line sealing and filling operations; jaw or band-type sealers for seals that will not be subjected to immediate stress. Impulse sealing requires less heat, which is more rapidly dissipated, permitting the sealed area to cool and return to full strength sooner. Faster cooling can be achieved with water-cooled backing plates.

Many of these points apply to other kinds of sealers as well as to those mentioned. Further information is given in U.S.I.'s booklet, "Heat Seal Characteristics of Polyethylene Films and Coated Substrates". Write for your copies. And if you have specific problems, contact U.S.I. Technical Service engineers for expert assistance.

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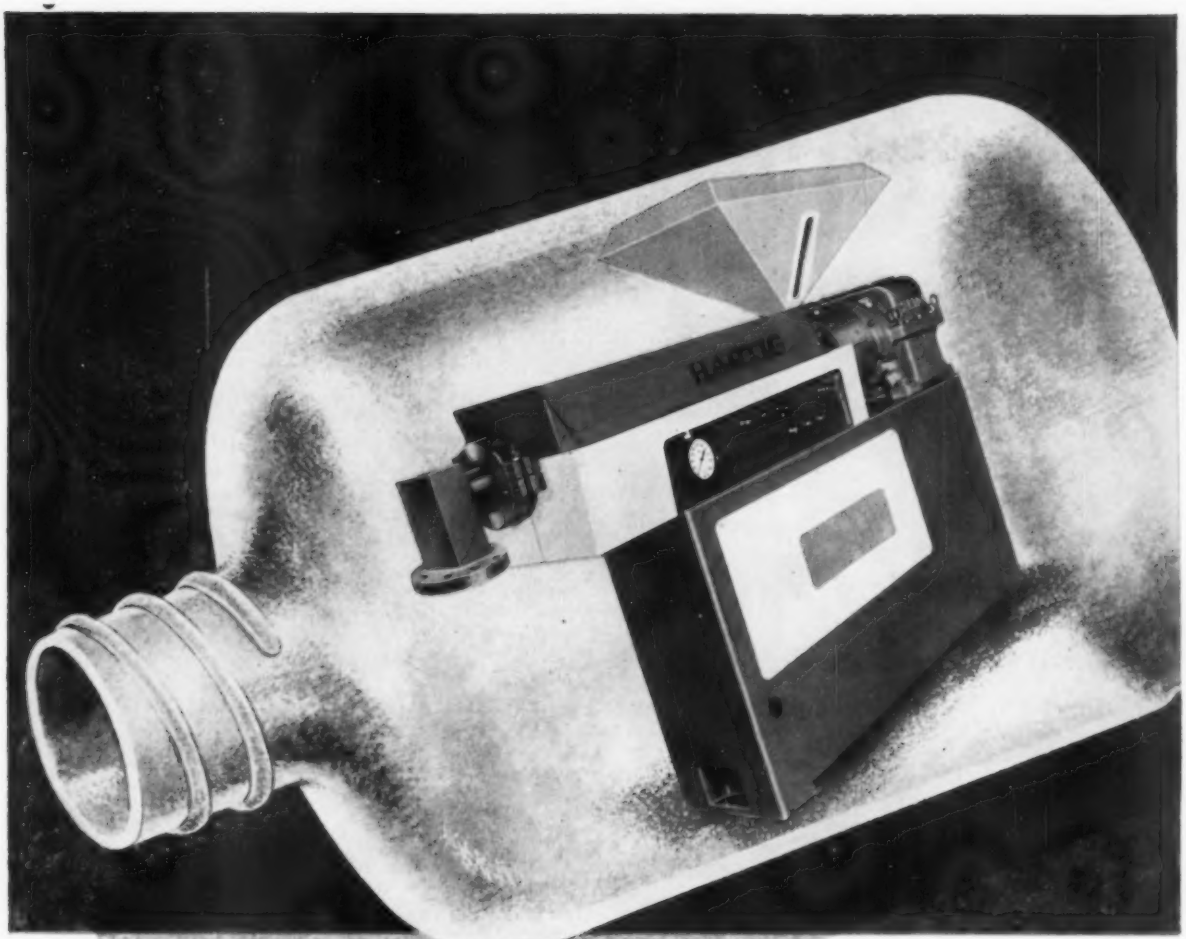

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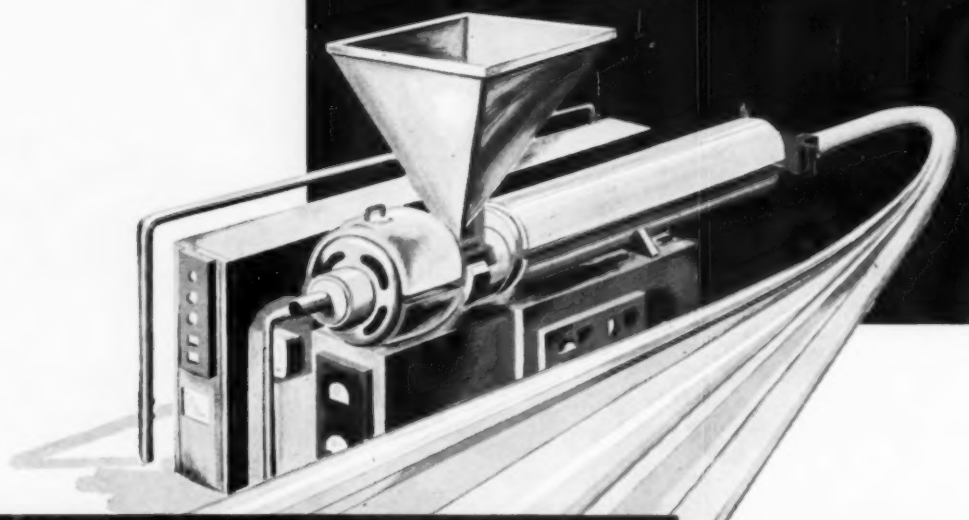

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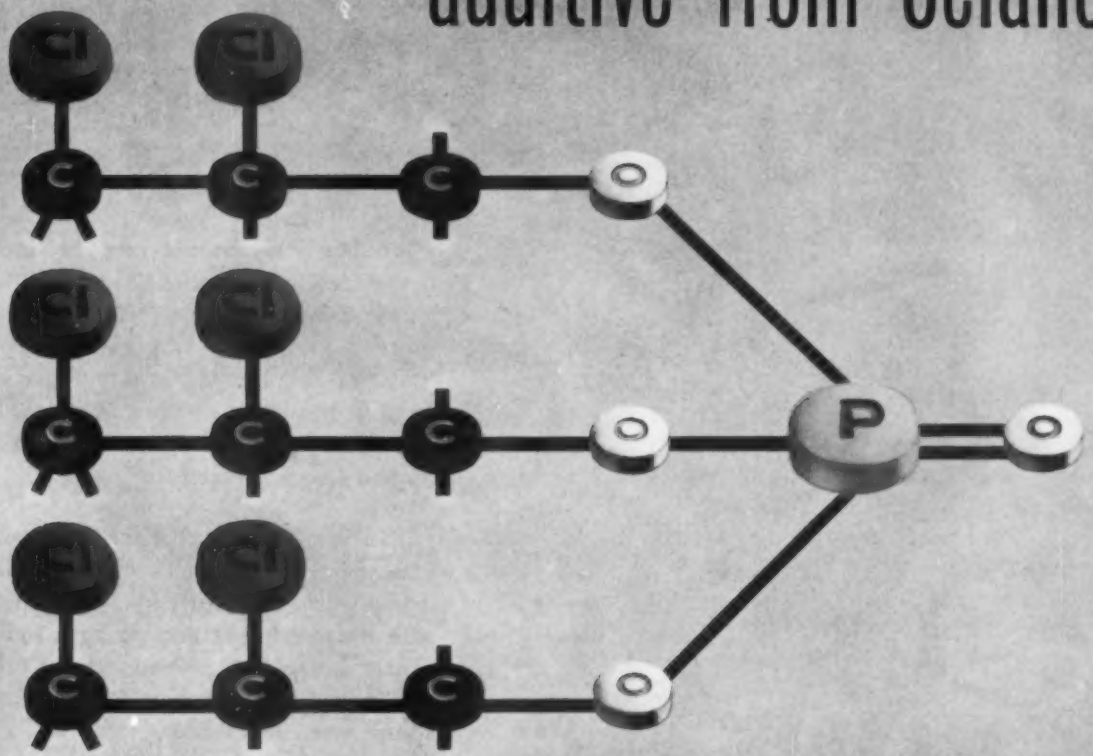

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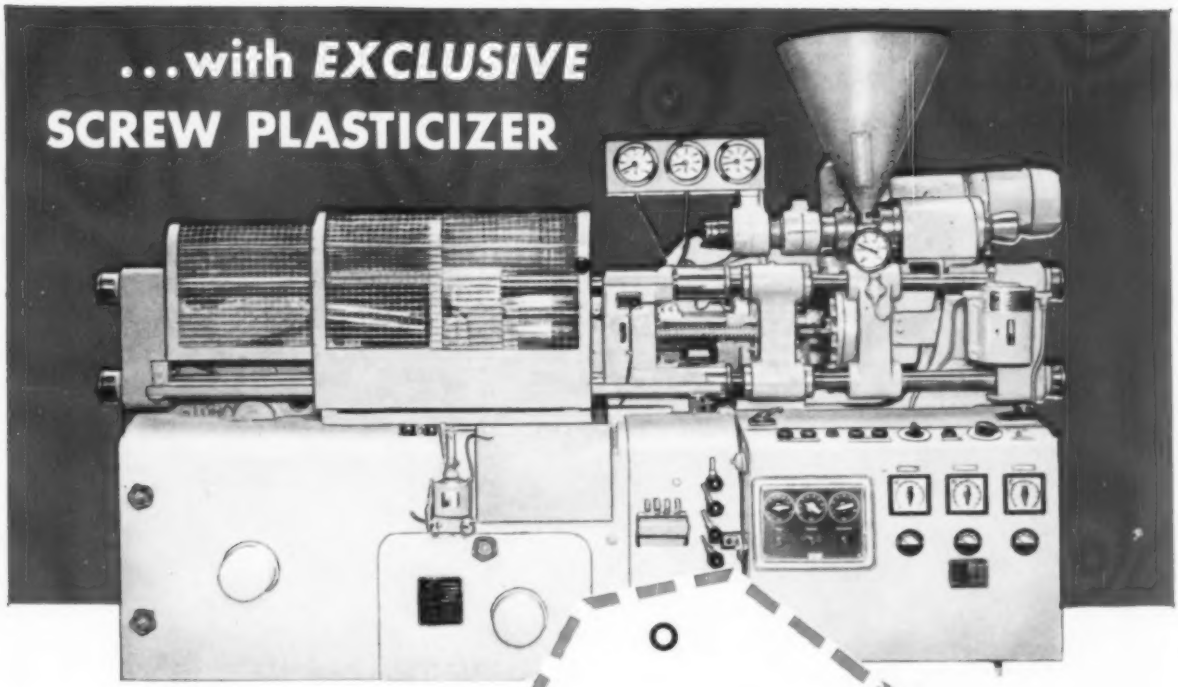

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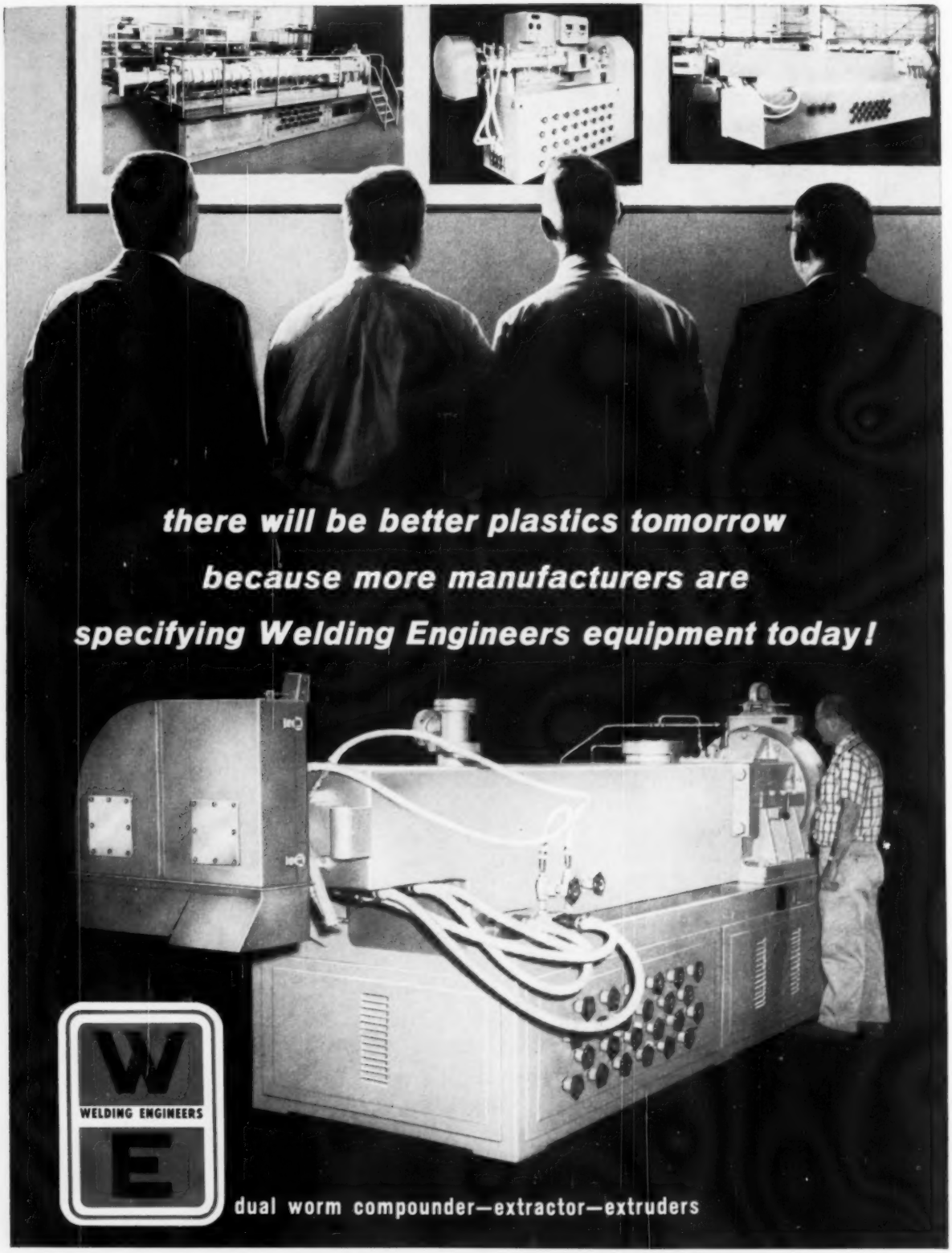

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PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
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Fixed-orifice pressure control for extruders

How to determine whether your extruder needs some type of valving mechanism.

B. H. MADDOCK*

Pressure control is of recognized value in providing improved resin and temperature homogeneity, better mixing characteristics, and, ultimately, an improved product at increased output, with excellent finish and freedom from roughness. Most extruder manufacturers presently are offering some type of valving mechanism between the extruder screw and the forming die to control pressure. This is standard or optional equipment with new machines, but special valves or valved adaptors for specific applications can be built.

The majority of existing installations do not contain valves, however, and the user is frequently faced with the question as to whether addition of a valve would accomplish enough improvement to justify the engineering and constructional costs involved. This report describes a simple, rapid, and inexpensive method, using fixed orifices, for answering this question. In some cases, the fixed orifice has proved to be a complete solution by itself, thereby obviating the need for a more versatile, adjustable valve.

Discussion

The general condition for fluid flow through a die or orifice is given by the following equation:

$$Q = \frac{\Delta P}{K\eta} \qquad (1)$$

$$\text{or } \Delta P = K\eta Q \qquad (2)$$

where: Q = volume rate of flow, in inches/second
ΔP = pressure drop across orifice, in psi.
η = resin viscosity, in lbs.-sec./in.^{2}
K = orifice resistance constant, in in.$^{-3}$

The resistance constant, K, for a circular orifice is given by:

$$K = \frac{128\,(L + 4D)}{\pi D^4} \qquad (3)$$

where: L = land length, in inches
D = orifice diameter, in inches

If the resin viscosity, η, is constant, it is seen from Equation (2) that the pressure drop is directly proportional to the extrusion rate. Actually, the viscosity of most thermoplastic polymers is not constant for a given temperature and molecular weight, but depends, in addition, on the velocity through the orifice or the rate of shear. The nominal rate of shear in a circular orifice is as follows:

$$\gamma = \text{shear rate} = \frac{32Q}{\pi D^3} \text{ sec.}^{-1} \qquad (4)$$

A plot of shear rate versus extrusion rate is shown in Figure 1 for extrusion of 0.920-density polyethylene at 190° C. through 0.050-0.250-inch diameter orifices.

Bruce H. Maddock was born in Wyandotte, Mich., in 1911. He attended the University of Michigan, receiving a B.S. in Engineering Physics in 1934. From 1935-1942, he was a Development Engineer for Bakelite Co.; from 1942-1945, Chief Engineer for Wire & Cable for Federal Telephone & Radio Corp. Since 1945, he has been associated with Union Carbide Plastics Co. (Bakelite division), serving successively as Development Engineer, Group Leader, Development Associate, and now as Development Scientist. Practically all of his industrial experience has been in the field of plastics extrusion, with 10 published articles since 1952, and he is now engaged in fundamental studies of screw extrusion processes. He is a member of SPE and conducts the Speaking of Extrusion column for the "SPE Journal."

Mr. & Mrs. Maddock have two children, and make their home in Fanwood, N. J.

* Development Scientist, Union Carbide Plastics Co., Div. of Union Carbide Corp., Bound Brook, N. J.

This plot indicates the order of magnitude of the shear rates involved. At 100 pounds per hour, for example, the shear rate in a 0.250-inch diameter orifice would be about 650 sec.$^{-1}$. This would increase to about 80,000 sec.$^{-1}$ if the diameter were reduced to 0.050-inch.

Orifice Design

By use of Equations (2), (3), (4), and the viscosity versus shear rate characteristics of the plastic material, the design of an orifice to develop a specified pressure is easily achieved. Figure 2 depicts several types of orifices. One of the simplest and easiest to construct is shown in Figure 2A—the single hole breaker plate. This type is frequently used as a starting point to check the accuracy of the theoretical design and to determine the

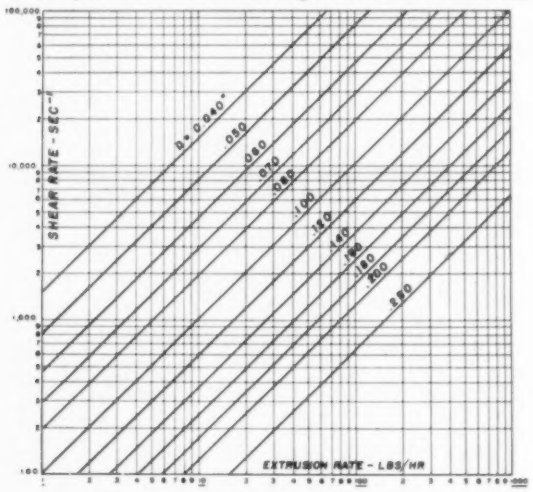

Fig. 1. Shear rates versus extrusion rates.

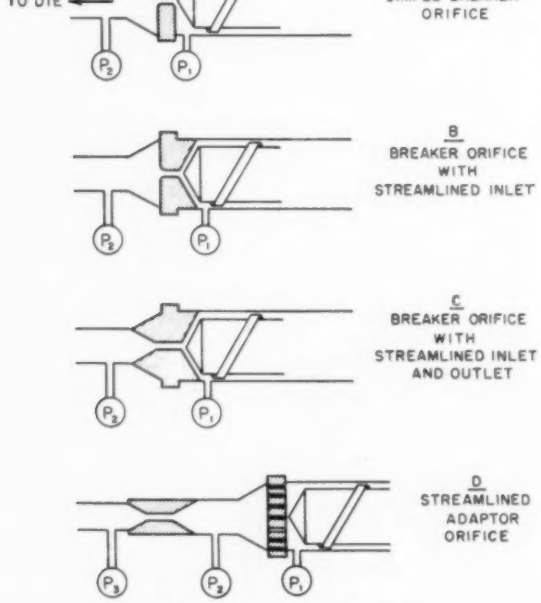

Fig. 2. Typical extruder orifice types.

potential advantages of the pressure control. Obviously, it is not ideal from a material hang-up standpoint since the obstructed areas on both sides of the plate are potential stagnant points where decomposition could occur. While this would not be serious for polyethylene, it would be highly inadvisable for thermally-sensitive materials such as the vinyls. Figures 2B and 2A illustrate alternative, streamlined versions of the single-hole breaker plate.

Another disadvantage of the single-hole breaker orifice is the reduction in screening area if screens are felt to be necessary for filtering purposes.

A further problem in the use of a breaker plate orifice is that many older extruders are not equipped with pressure gages, as shown at P_1 in Figure 2 (behind the breaker plate), although this feature now is considered standard on new equipment. Without a pressure measurement at this point, it is difficult to assess the results on a quantitative basis.

A type of orifice which eliminates most of the disadvantages of breaker plate-types is a simple adaptor insert, as shown in Figure 2D. Since the diameter of the orifice seldom will be greater than 0.250-inch, this type frequently can be slipped into an existing adaptor or feed line between the screw and forming die. Alternatively, a new adaptor containing provisions for such orifice inserts can be made at relatively little expense.

A pressure gage at position P_2 in Figure 2 is desirable and usually can be added without difficulty. A pressure gage at P_2, while not essential, gives added information both as to the actual pressure drop across the orifice, and the pressure created by the forming die. This system also retains the normal breaker plate and provisions for screening (if needed). Gage P_1 will in-

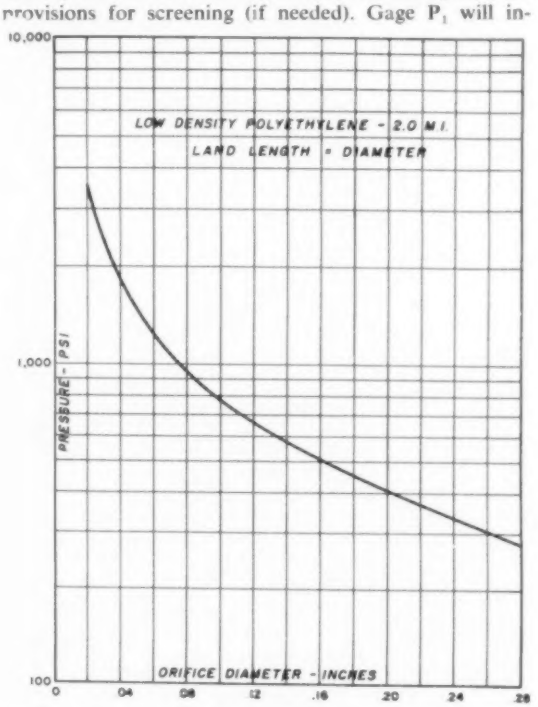

Fig. 3. Pressure required to extrude 2.0 melt index polyethylene at 50 lbs./hr. through a single orifice at 190° C.

dicate pressure build-up as a result of screen clogging.

Selection of the proper orifice size is achieved by means of a series of graphs. Figure 3 gives the pressure required to extrude 2.0 melt index polyethylene at 50 lbs./hr. through orifices of different diameters, at 190° C. The length of the orifice for this graph is equal to the diameter. A basic pressure for these standard conditions is determined from Figure 3, and then corrected for departures from these conditions by use of Figures 4-7 where multiplying factors can be obtained.

Figure 4 gives the correction factor for L/D ratios other than 1:1. diameter. (If the orifice had a length of six diameters, for example, the pressure from Figure 3 would be multiplied by 2.0. This relationship is obtained from equation 3.)

Figure 5 gives the correction factors for temperatures differing from 190° C. This also is a function of shear rate, so one must first determine the approximate shear rate in the orifice from Figure 1, and interpolate between the curves of Figure 6 to obtain the proper temperature correction factor. The correction factors for rates other than 50 lbs./hr. are given in Figure 6. Finally, Figure 7 gives the correction factor for melt index values differing from 2.0. This, again, is a function of shear rate so we must use the shear rate from Figure 1 and an appropriate interpolation between the curves of Figure 7.

The pressure drop across any orifice now can be determined. Consider the following example with low-density polyethylene having a melt index of 0.30; an orifice diameter of 0.100-inch; an orifice length of 0.600-inch or 6.0 diameters; an extrusion rate of 100 lbs./hr.; and an extrusion temperature of 220° C. The basic pressure for a rate on 50 lbs./hr., taken from Figure 3, is 775 psi. The length correction, taken from Figure 4, is 2.0. The shear rate, taken from Figure 1, is 10,000. The temperature correction, taken from Figure 5, is 0.8. The rate correction, taken from Figure 6, is 1.23. Finally, the melt index correction, taken from Figure 7, is 1.65. The pressure drop across the orifice then is: 775 x 2.0 x 0.8 x 1.23 x 1.65 = 2,520 psi.

This pressure would be added to the pressure developed by the die (the reading of gage P_2) to give the total head pressure at P_1 gage. If this pressure is not the desired value, either the length or diameter of the orifice can be altered, as required. Changing the length will change the pressure by something less than a linear relationship. Increasing or decreasing the land length by 50% from the original value of six diameters, for example, causes only a 30% change in pressure (see

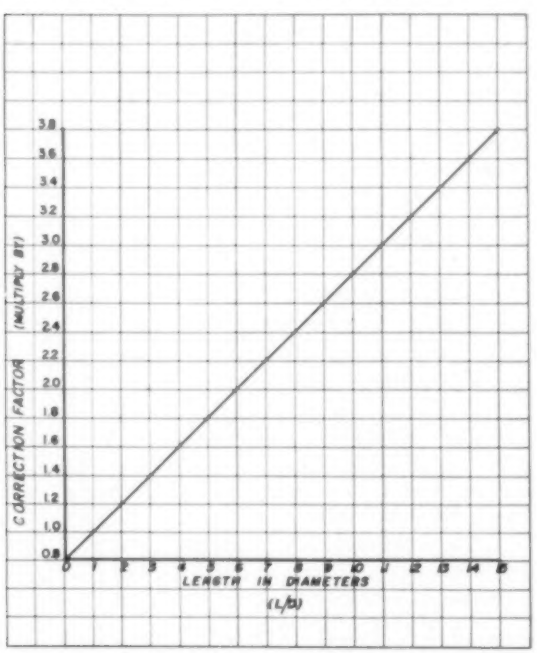

Fig. 4. Correction for orifice lengths different than one diameter.

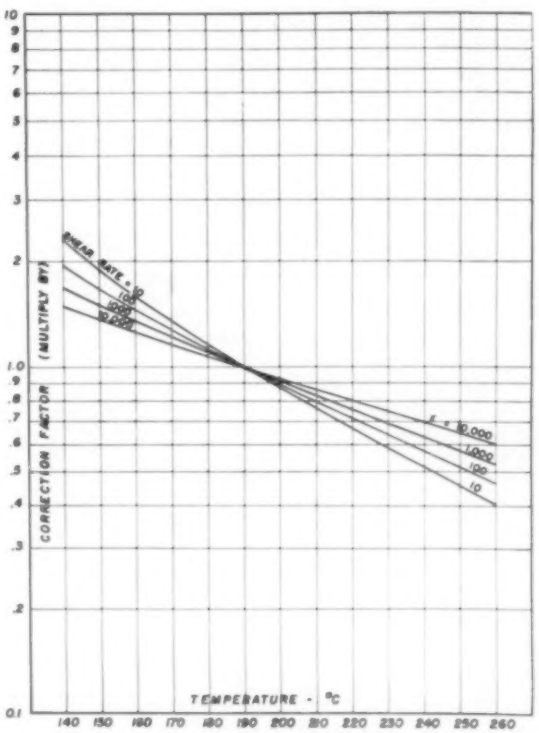

Fig. 5. Correction for temperatures different from 190° C.

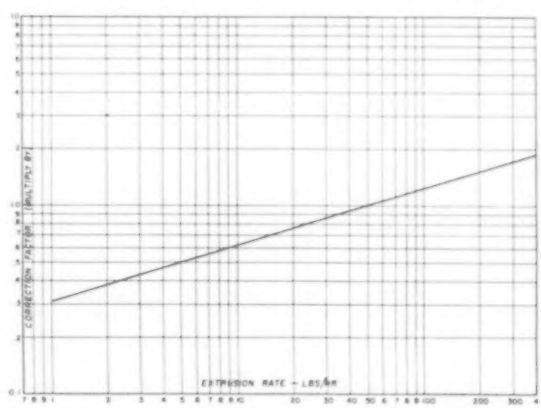

Fig. 6. Correction for extrusion rates different from 50 lbs./hr.

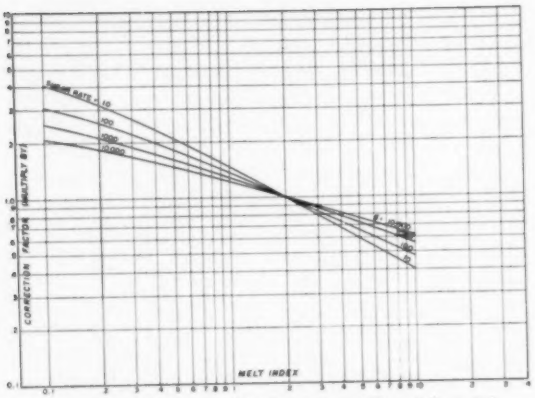

Fig. 7. Correction for melt index values different from 2.0.

Figure 4).

In many cases, it will be easier to alter the diameter of the orifice since the length may be determined by physical size limitations. A practical system using adaptor insert orifices (see Figure 2D) involves the construc- of several, varying in diameter in a ratio of about 3:1, such as 0.050-inch, 0.075-inch, 0.100-inch, 0.125-inch, or 0.150-inch. Orifices of this type can be replaced easily and quickly, and it will be a simple matter to determine experimentally the size that gives optimum performance.

Multi-Hole Orifices

The charts also may be used to determine the pressure developed by multi-hole orifices or breaker plates. From Figure 3, we see that a single-hole 0.100-inch diameter and length extrudes 50 lbs./hr. at 755 psi. If there were 10 holes of the same size, each would extrude 50 lbs./hr. at this pressure for a total of 500 lbs./hr. Applying a rate correction from Figure 6 for an assumed actual total rate, 250 lbs./hr., for example, through the 10 holes of 25 lbs./hr. for each hole, the actual pressure drop would be: 775 x 0.808 = 626 psi.

At 1,000 lbs./hr. through this 10-hole orifice (100 lbs./hr./hole), the pressure drop would be: 775 x 1.23 = 953 psi.

Corrections for length, temperature, and melt index would apply in the same manner as in the case for a single-hole orifice.

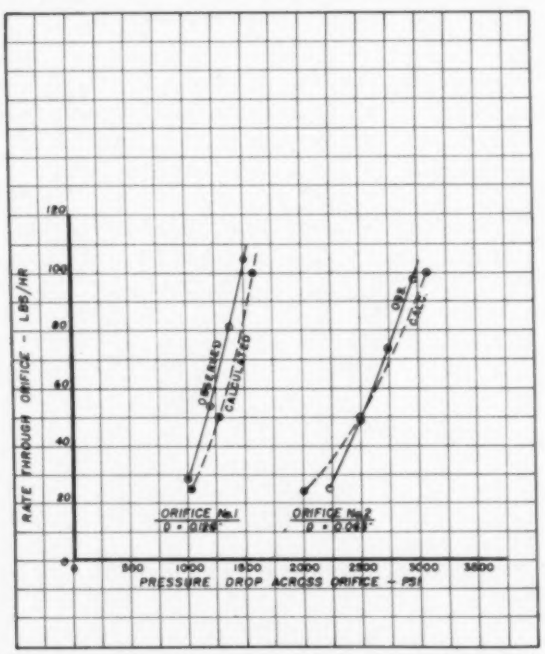

Fig. 8. Verification of design theory, both obseved and calculated, for 2.0 melt index polyethylene at 190° C. using two different test orifices.

Other Materials

The techniques described above are based on average viscosity versus shear rate characteristics of low-density polyethylene. Individual lots and other types of polyethylenes may vary slightly in this property, leading to small errors in calculated pressures at the higher rates of shear.

Information on viscosity and shear sensitivity of other polymers over wide ranges of temperature and molecular weight is somewhat limited, and graphs similar to Figures 3-7 have not been developed. Basically, the pressure requirement with any material is a direct function of its melt viscosity (see Equation 2), and an increase in pressure must be expected with an increase in melt viscosity or molecular weight. This is covered by the melt index correction for polyethylene in Figure 7. Viscosity data on the common thermoplastic extrusion materials are given in (1)*.

Actually, the melt viscosity range for most thermoplastic extrusion materials, at extrusion temperatures normally used for each material, is very similar to the range for polyethylene in its working temperature range. Pressures developed by the orifice, therefore, are not markedly different from those observed with polyethylene. A notable exception is unplasticized (rigid) polyvinyl chloride which, because of thermal instability, cannot be operated at temperatures high enough to lower the viscosity into this range. On the other hand, normal pressures in extrusion of rigid PVC are high as a result of the high viscosity, and additional pressure-control devices ordinarily are not required with this material.

Orifice designs based on polyethylene thus can be employed with most other materials. If a series of orifices of different diameters is available, a little experience soon will indicate which is the proper one for a particular polymer and product.

Verifying Design Theory

As a check on the design theory, two orifices were made and evaluated in the system shown in Figure 2D. Polyethylene of 2.0 melt index was used, and the exit stock temperature controlled at 190° C. The orifices had the following dimensions:

	Orifice #1	*Orifice #2*
Diameter, inches	0.126	0.063
Land length, inches	0.766	0.422
L/O proportion	6.07	6.7

* Numbers in parentheses refer to Bibliography at end of article.

(Continued on page 54)

How to set up control systems that will point up cost changes before they are out of control.

Determining unit costs in the molding plant

D. A. DEARLE*

The success of plastics molding operations depends, perhaps more so than in most industries, on a steady flow of production. Large volume and the maintenance of round-the-clock molding cycles are key factors in realizing profits over an annual period. This is due to the fact that plastics molding is a relatively rapid operation. From multiple-cavity molds came thousands of pieces per hour, and molding presses usually are kept operating on either a two- or three-shift schedule. Consequently, a constant watch must be maintained not only on the quality, but also on the actual cost of the parts being molded.

In view of the inflationary trend of our economy today, direct labor is the most important component of any cost sheet. Over-head costs are keyed to direct labor and, therefore, any system which is used to keep a watchful eye on the cost of labor will keep management informed on profits or losses. Although the annual profit-and-loss statement is an essential report, other means of ascertaining the ups and downs over shorter periods of time now are necessary. Concurrent cost control is not too complicated if certain steps are taken at the outset of production runs. By instituting an inexpensive system, the weekly cost of parts may be obtained. Comparative figures then can be maintained by the use of arithmetical calculations. These statistics may be recorded in either tabular or graphical form. The actual unit-cost per dollar can be obtained by carrying out the following procedure.

Controlling Labor Costs

First, a summation of the number of employees engaged in direct labor should be made. Secondly, the total quantity of goods molded should be listed, with the different products segregated to obtain the number of pieces of each item. Finally, the total number of items produced should be multiplied by the minimum selling price of each item to obtain the lowest possible production value. Addition of these figures will give the total worth of production over a given period and, hence, a basis for comparison with similar figures over some other week. Comparative costs of labor from week to week may be obtained from the payroll figures. Production values should be available by referring to the latest selling prices of the respective products.

As an example, let it be assumed that a molding plant manufacturing eight different products produces a certain large volume in one week. The minimum selling price of each of these products, of course, is known. For further purposes of illustration, let it be assumed that the following parts were molded during the week:

Item	*No. of Parts Produced*	*Min. Selling Price Per M.*	*Production Value*
A	40,000	$ 40.00	$ 1,600.00
B	130,000	10.00	1,300.00
C	5,000	280.00	1,400.00
D	16,000	100.00	1,600.00
E	92,000	20.00	1,840.00
F	160,000	10.00	1,600.00
G	10,000	160.00	1,600.00
H	37,600	50.00	1,880.00
			$12,820.00

Addition of the production value column indicates a total figure of $12,820. This represents the minimum sales value of goods produced for the entire week.

In this hypothetical molding plant, there were 18

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Table I. Labor-Cost Statistics

Week Ending	(1). Production Value	(2). Number of Employees	(3). Total Hours	(4). Production Value/Employment Hr.	(5). Average Hourly Wage Rate	(6). Unit Cost Per Dollar	Remarks
5/21/60	$12.820.00	18	720	$17.80	$2.00	0.112	
5/28/60	11,560.00	18	700	16.51	1.96	0.118	Man out ½-wk.
6/4/60	13,200.00	20	800	16.50	2.00	0.121	New help.
6/11/60	13,400.00	20	800	16.75	2.10	0.125	New 5% raise.
6/18/60	14,470.00	22	880	16.44	2.14	0.130	
6/25/60	15 890.00	22	880	18.06	2.12	0.117	Selling Price up 8%.
7/2/60	14,160.00	22	860	16.46	2.12	0.128	Absenteeism.
7/9/60	13,100.00	22	710	18.45	2.14	0.116	July 4th holiday.

Explanation:
(1). Obtained by multiplying total units by minimum sales price each unit.
(2) & (3). Directly from time cards.
(4). Obtained by dividing Column (1) by Column (3).
(5). Average of all rates per hour for the week.
(6). Obtained by dividing Column (5) by Column (4).

employees working throughout the week in the molding, finishing, and inspection departments. The plant was operated on a two-shift schedule, and each employee worked 40 hours. Therefore, the total amount of direct-labor time amounted to 720 hours. In order to ascertain the total payroll expenditure for direct labor, the wage rates now must be applied. Were these uniform, it would be a fairly easy calculation, but there are variations according to job and also according to the time of day that the labor is performed. In this particular week, piece-work wages were equivalent to the following hourly rates:

6 male employees at $2.00 per hour
6 female employees at $1.80 per hour
6 male employees at $2.20 per hour

The second shift pays a 10% bonus and, hence, the $2.20 rate for the second group of male employees. If the total number of hours for each employee amounted to 40 for the entire week, then the total payroll would be obtained as follows:

$$(6 \times 2) + (6 \times 1.8) + (6 \times 2.2)\ 40 = \$1,440.00$$

If this total is divided by 720, then the average wage rate for the goods manufactured has been established. It is known that during a week of operation the total production value amounted to $12,820 and that the average wage rate was $2.00 for producing these goods. Therefore, it now is possible to post statistical figures in tabular form.

Table 1 shows the unit cost per dollar. These are the figures obtained for a number of weeks and calculated on the basis of pertinent production values and wage rates.

Although all the figures in the various columns are important to the cost analyst, it is the unit cost per dollar of direct labor expenditure which is of major interest to management. The figures appearing in the last column, therefore, should be plotted on a 12-month chart. Thus, comparative costs can be observed from one year to another, and the progress of unit costs can be followed at a glance.

Discussion

Analysis of the eight-week production figures discloses many interesting facts. Perhaps a close examination should be made to determine why the labor costs have shown such wide fluctuations over the two-month period.

For the week ending May 21, the production value as shown is the result of figures arrived at on the basis of running eight different items. This apparently was a normal or average week so that no remarks were deemed necessary. During the next week, however, the production value declined even though the number of employees remained the same. It will be noted that the total number of employee-hours went down, but this discrepancy is explained in the remarks. With one man out for one-half week, the production value declined and the unit cost commenced to climb.

In looking at the succeeding three-week records, management undoubtedly would become concerned with the continuing rise in the unit-cost per dollar. In fact, a glance at this last column indicates a steady increase in labor cost per unit for five consecutive weeks. However, some explanation is found in the fact that new employees were added to the payroll, and also the fact that a 5% raise was put into effect during that period. This added expense makes itself manifest in the average wage-rate column. There, it can be seen that the rate has been increased gradually from $2.00 to $2.14 per hour.

As a result of increased costs, management evidently decided at this point to put a sales price increase into effect. The results of this 8% increase become apparent immediately during the week ending June 25, where a higher production value is found. Most important is the improvement shown in the last column. There the rise in the unit-cost per dollar has been stopped, and a substantial gain made in reducing this element of cost.

It will be noted that raw material costs have not been included in the calculations. These do not vary from week to week in the manner of direct labor

(Continued on page 72)

R. H. Calderwood

A. J. Bush

Tensile-impact measurements on reinforced plastics

A practical test method that picks up greater differences between materials than does the Izod impact test

R. H. CALDERWOOD* and A. J. BUSH*

The range of tensile-impact strength values for a representative group of molded premix and laminated reinforced plastics is given in this paper. Data was collected for presentation to try to stimulate an increased interest in the use of the tensile-impact test as a tool for control testing of molded and laminated parts.

Tensile-impact strength data has been used successfully to evaluate thermoplastic molded articles and place them in the order of their relative impact resistance, as indicated by service tests on molded parts (1). Switchgear parts such as bus-bar supports have been evaluated to find an impact resistant composition for commercial molding.

In the electrical industry, circuit-breaker trip fingers, links, insulated tie bolts, tie bars, supports, trip bars, and generator coil supports are only a few of the applications where knowledge of material tensile-impact strength is important.

The specimen cross-section used by other investigators was not large enough to be representative for reinforced plastics, nor the right shape (2) to be molded in or machined from reinforced plastics. In order to overcome these difficulties, a specimen cross-section was chosen which could be proportioned to an existing ASTM tensile strength specimen (ASTM D651-48). The specimen cross-section was rectangular, and specimens could be cut readily from flat laminates, or molded in a simple compression mold. The jig for holding these specimens could be adapted readily to a standard impact testing machine.

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Numbers in parentheses refer to Bibliography at end of article.

Test Program

Many methods have been devised for determining the impact resistance of plastics, probably the most widely used being the Izod test. Other tests have been devised which can be applied to finished parts or molded sheets to measure their relative resistance to impact.

Many investigators believe that most failures caused by impact loading in service are tensile failures (1,3). Recent publications reveal a desire on the part of plastics manufacturers and users to know more about the actual values that can be placed on the tensile-impact resistances of the materials they use. In the past, the assumption has been made that a material's ability to withstand impact loading could be judged from its tensile, Izod impact, and flexural strengths. All these values contribute to our knowledge of the strength of a material, but do not give a definite value to be placed on its resistance to actual tensile loading at impact velocities.

Laboratory model Izod impact testing machines have been built or modified to measure the tensile-impact

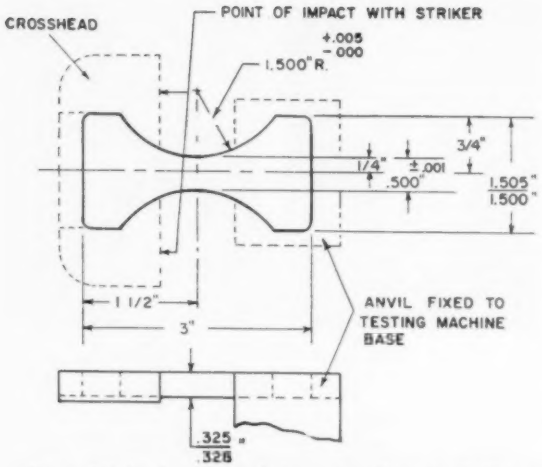

Fig. 1. Details of specimen design and method of gripping.

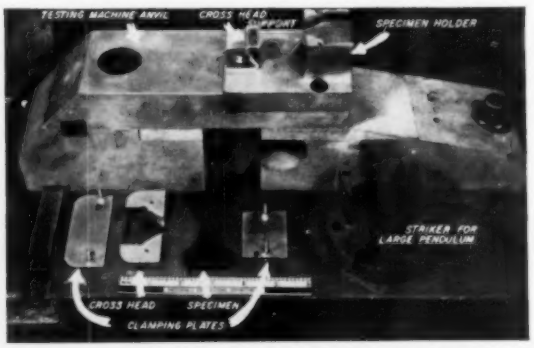

Fig. 2. Various components designed for use with Sonntag impact machine when making tensile-impact tests on plastics.

strength of materials (1). Most of the measurements reported were on thermoplastic materials or films where small sample cross-sections could be tolerated. It was our thought that glass fiber-reinforced plastics should be tested using a sample cross-section (as shown in Figure 1) to permit good distribution of the fibrous reinforcement in the test section. A standard Charpy-Izod impact machine of 240 foot-pounds capacity was modified by changing the base and striker to test a sample so designed that it could easily be molded from premix materials or machined from fiber-reinforced sheets.

Machine Modification

A Baldwin-Lima-Hamilton Sonntag Impact Machine of 240 foot-pounds testing capacity was modified for use in tensile-impact testing. The testing machine components after modification are shown in Figure 2. The present machine modification was designed primarily for testing materials that would be in the higher tensile-impact strength bracket. (Low impact-strength materials would not ordinarily be considered for these applications.) A tensile-impact specimen in place for testing but with the sample clamping plates removed is shown in Figure 3. A view of the modified striker in place in the pendulum ready for testing is shown in Figure 4.

The striker mounted in the pendulum head comes in contact with a cross-head attached to the specimen. The other end of the specimen is mounted in the anvil of the testing machine. The location of the cross-head was chosen so that the calibration of the testing machine was not affected. The striker and cross-head are located so that no bending takes place in the sample when contact is made, and a pure tensile force is exerted on the specimen. The anvil, cross-head, and striker were made from hardened tool steel to minimize strain-energy losses during testing.

Specimen Preparation

A compression mold was built whose cavity would produce a specimen of the size and shape shown in Figure 1. Any of the premix type materials may be molded using the suitable conditions of temperature and pressure which are generally used for that material. Six or more specimens of each material were molded for testing.

The laminated materials were machined to dimensions from flat sheets of commercially-available material, or from sheets molded in a laboratory compression mold.

Testing Procedure

Specimens of each material were tested at a pendulum velocity of 17 feet per second and, in certain cases, duplicate specimens were tested at a pendulum velocity of 11 ft. per second. A knowledge of the approximate strength of the material being tested determined which of two weights of pendulum were

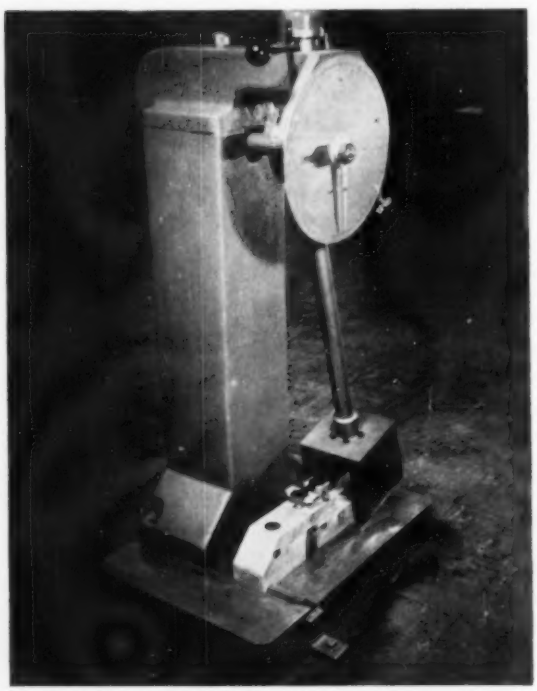

Fig. 3. Specimen in position for tensile-impact testing. Clamping plates are omitted for clarity.

used. The smaller pendulum was used for testing the lower strength (premix) materials with measurements made at a velocity of 11 feet per second at a scale range of 0-25 foot-pounds, and at a velocity of 17 feet per second using a scale range of 0-60 foot-pounds. The large pendulum was used for testing the higher strength (laminated) materials. At a velocity of 11 feet per second, the scale range used was 0-100 foot-pounds, while at a velocity of 17 feet per second, the 0-240 foot-pound scale was used.

A specimen was placed in the holder on the anvil of the testing machine and clamped in place by the coverplate shown in Figure 2. The cross-head was clamped on the other end of the sample as shown, and rested on the cross-head support. The pendulum was released from a predetermined height to strike the sample at a velocity of 17 or 11 feet per second, as desired. The energy, in foot-pounds, absorbed in breaking the specimen could then be read from the appropriate scale.

The design of the specimens used in this work is shown in Figure 1, which also shows the method of gripping the specimen. There are no stress raisers at the gripping section of the specimen, since no notches or file faces are necessary with this gripping method. The specimen and grips were made to close tolerances in order that the alignment would be good. A short gage-length was used to minimize misalignment, and a curved gage-length was used to concentrate the location of the fracture. A radius : width ratio of three was used, which is similar to that used for the D651-48 test specimen. The specimen is curved only in one plane, to simplify the matching of specimens from flat-sheet laminated materials. Premix material molded specimens can be molded to size by an appropriate mold.

The volume of material in the gage section is large, when compared to that in the specimens tested by Bragaw (1). Specimens of different designs can be tested on the apparatus simply by changing the design of the specimen holder section of the anvil.

Results of tensile-impact strength tests have been reported as foot-pounds per "active volume". The active volume is the effective volume which absorbs the breaking energy, and is calculated by weighing each element of volume by the fraction of energy absorbed. In making the calculations, the assumption is made that impact specimens do not deform plastically before breaking. Since tests have proved that there is some draw, any mathematical analysis using present theories is not entirely correct.

Toss factor is the energy required to throw the free end of a broken specimen and the specimen holder. This toss factor varies with the energy required to break the specimen, and was determined experimentally for the machine.

Along with the tensile-impact strength per specimen the test report should include the velocity at which the test was conducted. Using the Sonntag machine, the test can be conducted at speeds of either 11 or 17 feet per second. Since the thickness of molded specimens can vary, the smallest cross-section dimensions should be included in the report, and considered when comparing energy values. Windage and friction corrections are unnecessary for the energy values in the ranges for which the Sonntag machine is designed.

Test Results

Different tensile-impact values are obtained from similar specimens when test pendulums are changed. This effect has been shown by many investigators who have found that test results for a material will change when strain rates and machine losses are changed. Changes in pendulum mass change both the strain rate and machine losses, and affect test results.

Some specimens of low impact strength were tested, using both the large and small pendulums (see Table 1). An energy reading could be obtained when using the small pendulum, but a reading of approximately zero was obtained when the large pendulum was used. Also, when using a testing velocity of 17 feet per second, rather than 11 feet per second, the energy values obtained were greater.

There is a change in tensile-impact energy values with different speeds of travel for the pendulum, as shown in Table 2. Properties of one material can be compared with those of another only if the same test conditions are used. The pendulum weight and the speed of the testing must be the same for both materials.

Fig. 4. Testing set-up prior to release of pendulum, showing striker mounted in pendulum.

Fig. 5. Premix specimens broken by tensile-impact. Center specimen, 4BS in Table 4, resisted shock best.

For classifying low-energy impact materials (that is, those having tensile-impact strengths of 0-2.00 foot-pounds), a machine with a maximum scale range of approximately 0-10 foot-pounds and a small or zero toss factor should be used. However, it should be possible to test them on the Sonntag machine in the 0-25 foot-pound range if the toss factor is eliminated or made small, and the specimen size is increased. The toss factor can be eliminated entirely by mounting the specimen in the pendulum head (4).

Rate of Loading

Samples of equal cross-section were broken at cross-head speeds of 0.16 and 28 inches per minute, and at impact velocity of 17 feet per second (12,240 inches per minute). The ratio of the velocity of load application was 1-175 and 76,563, respectively. The results given in Table 3 are in terms of the breaking load in pounds for each specimen, and foot-pounds per specimen necessary to cause a fracture in specimens of equal cross-section. Although no direct relationship is readily obtained between the pounds and foot-pounds data, the figures show the load that a specimen might support when loaded statically, as compared to the load that it would support when the load was applied much faster or when the load was applied as a mass dropped through some distance to produce a shock on the material.

The results for the premix material (see Figure 5) show the increased strength imparted to the material when the glass-fiber integrity was not destroyed or impaired during the manufacture or molding of the compound. All of the compounds have the same glass content, but 4BS was the most resistant to shock (see Table 4). Neither the Izod-impact nor the tensile strength clearly show this difference.

The results on the glass-mat laminated materials show that they would resist shock loading to a greater degree than the premix materials, but the materials decreased in strength in every case as the rate of loading increased for the velocities investigated. The type of break produced in the specimens also illustrates the differences in the effect of fiber arrangement, and is shown in Figure 6.

The importance of the arrangement of the reinforcing fibers was shown in another series of measurements, see Table 5. Laminates of various compositions were tested, as shown in Figure 6. The laminate with the glass roving in it had roving arranged parallel to the direction of load application. The resistance to impact-loading increased considerably as the fibers were arranged more parallel to the direction of load application. This difference in material is not shown when tensile strength results are used as the means of classification.

The photographs of the breaks in the same laminates caused by a slow rate of loading (see Figure 7) do not show that a considerable volume of material was strained as in the samples (shown in Figure 6) which were broken by impact loading. The tensile-impact test is useful for classifying materials as to their relative resistance to shock. Table 6 shows the differ-

Table 1. Effect of Pendulum Mass on Tensile-Impact Values#

	Large Pendulum		Small Pendulum	
Speed, Ft./Sec.:	17	11	17	11*
Materials				
Premix Batch #9	0	*	2.50	1.75
Premix "A"	2.0	*	2.75	0.50
Premix 4-AS	9.0	6.0	5.25	4.25

* Off scale; no reading possible.
\# Values at 11 feet/second lower due to more energy absorbed by cross-head of testing machine, and change in strain rate in specimen at lower velocity of testing.

Table 2. Tensile-Impact Measurements at Two Loading Rates

	Tensile-Impact Values, Ft.-Lbs./Cu.In.		Pendulum Size
Loading Rate, Ft./Sec.:	17	11	
Premix Materials:			
Batch #9	16	11	Small
Batch 4-AS	35	30	"
Laminated Materials:			
"A"	128	82	Large
"B"	294	216	"
"E"	172	83	"

Table 3. Breaking Loads in Tension at Two Loading Rates Compared with Tensile-Impact Loads for Samples of Equal Cross-Section.

		Load Application Speed Ratio		
		1	175	76,563
	Pendulum Size	Tensile Breaking Load, Lbs. At 0.16 Ft./Min.	At 28.0 In./Min.	Tensile-Impact Breaking Load at 17 Ft./Sec.
Premixes:				
Batch #8	Small	330	91	0.25
Batch #9	"	730	195	2.5
Batch #4-BS	"	1,330	690	15.75
Laminates:				
121-A	Large	1,680	905	23.2
E	"	2,380	890	26.6
122-A	"	3,040	890	32.0

Table 4. Tensile-Impact Differences Not Revealed by Other Physical Test Results

Premix	Size of Pendulum	Tensile-Impact, Ft.-Lbs./Cu.In. At 17 Ft./Sec.	Izod Impact, Ft.-Lbs./In.	Tensile Strength, Psi.
A	Small	18	9.0	7,500
4-BS	"	102	12.6	8,400
9	"	16	3.2	5,500

Table 5. Comparison of Tensile-Impact and Tensile Strength

Laminate	Glass Content, % by Str.	Glass Type	Type of Pendulum	Tensile-Impact, Ft.-Lbs./Cu.In.	Tensile Strength, Psi.
	25.5	Mat	Large	113	10,500
121-A	33.0	Mat	"	160	18,800
122-A	17.7	Mat	"	294	21,250
B	22.6	Roving			
C	34.5	Cloth	"	585	16,700

Table 6. Comparison of Tensile-Impact, Tensile Strength, and Izod Impact Values

	Tensile-Impact, Ft.-Lbs./Cu.In	Tensile Strength Psi.	Izod Impact, Ft.-Lbs./In.
Premix 4-AS	35	8,550	5.0
Laminate A	128	9,750	5.1
Nylon (Saturated)	317	11,250	4.1
Premix 128-P*	10	4,050	1.5
Premix 129-P#	19	5,850	1.6
Premix 131-P**	44	7,960	1.4
Laminate 68-121-A*	113	13,700	14.0
Laminate 175#	105	15,950	7.9

* Premix 128-P and Laminate 68-121-A were made with general-purpose polyester resins.
\# Premix 129-P and Laminate 175 were made from the same commercial isophthalic polyester.
** Premix 131-P was made from a second isophthalic resin.
NOTE: The percentage compositions of the premixes were the same. The laminate compositions were identical.

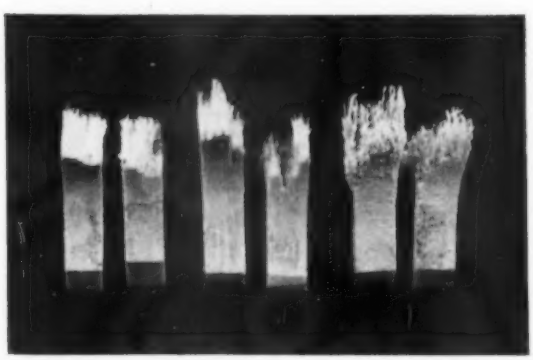

Fig. 6. Glass-reinforced laminate specimens broken by tensile-impact. Note fiber arrangement.

Table 7. Discrepancies in Test Data that Demonstrate Need for More than One Test to Prove Materials for an Application

	Tensile-Impact, Ft.-Lbs./Cu.In.	Tensile Strength Psi.	Izod Impact, Ft.-Lbs./In.
Laminate B	245	21,250	19.5
Nylon (Saturated)	317	11,250	4.1

ences found in three materials that would be equally resistant to impact loading when judged on the basis of their Izod-impact strength, but acted in a quite different manner when loaded in tension.

The need for more than one set of physical properties to describe a material as being suitable for a certain application is shown in Table 7. Both materials have good tensile-impact resistance, but the desirable properties shown by the other physical properties may be equally important in placing the material in its proper perspective for use in a given application. Nylon is the more ductile of the two materials, and this may not be important in the application. The glass-mat laminate would be a more rigid material, and less susceptible to notch sensitivity.

A comparison of the tensile-impact on the Izod-impact strengths of various reinforced plastics and nylon are shown in Table 8.

Conclusions

A practical tensile-impact test has been developed for glass-reinforced plastics. A sample of larger cross-section was tested than generally has been used for tensile-impact testing.

(Continued on page 72)

Guest Editorial

Why an american plastics institute?

LOUIS F. RAHM*

I hope I do not abuse the hospitality offered me by the editor of this magazine by tossing out this challenge to the American Plastics Industry:

Are you ready for maturity?

If ever there was an industry that depended for its continued growth on a comprehensive program of basic research and broader education, that industry is plastics.

I know of no other industry that has more individual elements involved in a mutually-dependent team—the producers of materials (both the basic resins and the ancillary materials: coatings, plasticizers, extenders, etc), the machinery-builders, the mold-makers, the converters and the end-users.

Each of these individual firms—and its employees and their families—has a strong mutual interest in the continued growth and over-all success of the plastics industry.

Hence, all of these firms have a mutual concern for advancing the frontiers of knowledge that affect the success of their industry, and in increasing the supply of professional engineers and scientists needed to apply that knowledge.

But it is precisely these advances that no single element of the industry—or no narrowly-defined group within the industry— can make single-handedly. Basic research is too expensive for most individual firms to undertake, and is becoming increasingly more so. It is clearly a proper activity, we feel, for cooperative effort.

Education has always been recognized—from the founding of our Republic—as the responsibility and an appropriate function of society as a whole. Plastics education, too, should be a cooperative undertaking of the group that requires and will benefit from its "output."

Why, then, does America lag behind Europe in establishing a Plastics Insitute—which would be the instrument and focal point for cooperative, group-sponsored activities to carry on basic plastics research and education in plastics engineering-science at the graduate-school level.

A number of well-advanced and successful European plastics institutes are already in being—in Darmstadt, in Delft, in Milan, and several in Russia. These point up the soundness of the cooperative approach, and its recognition as such by these European countries.

Certainly America, with more than half the world's production of plastics, can hardly argue that it cannot afford its own institute! The Committee which I head feels strongly that America cannot longer afford not to have its own institute.

The fact is that a Plastics Institute for the United States has been proposed a number of times during the past fifteen or twenty years, and might have been established at any time during that period. During this time, the American plastics industry has doubled in size every five years. Last year it chalked up another 20% increase in the total value of its products—from $2.5 billion up to $3 billion.

This might be taken by some as a convincing indication of the health of the American industry. "Why tinker with success?" they might ask.

But in spite of its phenomenal past growth, the American plastics industry is only on the threshhold of its real future. Far greater advances lie ahead. But, also, far greater competition looms in the near future, from maturing foreign industries. For this potential growth to be achieved, and foreign competition to be met successfully, it will take more research effort and far greater educational activity than is now being carried on.

A growing number of people in the plastics industry —our Committee among them—believe that teamwork holds the answer to these two needs and that the time is now ripe for the creation of an American Plastics Institute.

We have laid our plans for such an Institute before the chief executives of more than 1,800 firms in the plastics industry and allied industries, in a comprehensive brochure. An accompanying questionnaire asked for their opinions and expressions of their willingness to support the proposed Institute.

We have been greatly encouraged by the early re-

(Continued on page 70)

* Chairman of Plastics Institute Committee.

Viewing PT's extruder specifications

. . . and auxiliary equipment data

L. J. ZUKOR

In compiling data on 1960 extrusion machines, we found certain common denominators for all units to be listed. Final selection of categories for comparison, however, was based on the considered opinions of experts in the field as well as our own experience. Although we do not expect 100% agreement on our classification system, we feel that it is a step in the right direction—a standard method of reporting machine specifications. We also wish to point out that our list is not intended as a complete specification sheet on all makes of extruders.

In any shop, big or small, one man should have the responsibility for purchase of equipment. His selections must be based on an accurate analysis of current and future needs. Factors to be considered include expected output, type resins used, product diversification, and equipment obsolescence. In selecting auxiliary equipment, he must be familiar with the items specific to the machines and processes employed in his plant.

Most extruders in current use are single-screw types driven by electric motors through gear reduction units and belts. The majority of drive mechanisms include some form of control for varying the screw speed. Material is supplied through a hopper and a feed-pocket which is usually made by cutting away a portion of the barrel near the hopper throat. This section of the barrel is generally water-jacketed to keep the incoming resin free-flowing. Screws for these machines are supplied both with and without passages for circulating cooling water.

Our method of presentation

The prime factor in extruder selection is output capacity. This appears in our listings as "Extrusion Capacity," and is based on a 0.92 density polyethylene with a melt index of 4.0—the resin in most common use. Hypothetically, if it were possible to duplicate the conditions, extrusion output would be less in polystyrene, greater in nylon. This is due to their different melt viscosities, and is also true of different resins within the same polymer group.

Many extruder manufacturers offer interchangeable screws with different compression ratios, thus enabling the processor to obtain optimum feed characteristics with specific resins. Compression ratio is an expression of resin volume between screw flights just forward of the hopper feed section to the volume between flights at the discharge end. This distance is the effective screw length.

Our listings identify extruders by screw diameter, expressed in inches for American-made machines, and in millimeters for foreign-made units. In comparing the two, we list a 60 mm. unit with the 2½-inch domestics, although its diameter is actually 0.14-inch less. The most commonly used extruders do not have screw diameters over 6 inches, though special models for mixing, dispersing, and pelletizing may range from 8 to 24. New models have been built with conical plasticators which reduce the length of screw required to plasticate the resin. These, in turn, permit a reduction in barrel size and overall length of the machine. Other special-purpose machines include the twin-screw units with both meshing and non-meshing screws.

Extruder size, however, depends on its L/D (screw length to diameter) ratio. A machine with a 20:1 L/D ratio (the most common) and a 2½-inch screw diameter would have an effective screw length of 50 inches. Extruder output varies with the L/D ratio, screw diameters, pitch, compression ratio, screw speed, and shape of the part being extruded.

Speeds range 10-400 rpm. in the smallest machines, the maximum speeds falling off as the screw diameter increases. An 8-inch machine generally has a maximum screw speed of 75 rpm. Output will be about 1,000 lbs/-hr. if the motor exceeds 200 hp. Outputs vary from 1 lb/hr. at 1 rpm. (100 lbs/hr. at 100 rpm.) for a 2½-inch machine to about 15 lbs/hr. at 1 rpm. for an 8-inch machine.

It is essential that whoever selects the extruder have a working knowledge of the materials which will be extruded. A variety of screw designs are available for use with the major resin groups. Although it is possible to run different polymers with a metering type screw, optimum results will be obtained using a screw designed especially for a specific material type. Some resins, because of their short thermal life and corrosive breakdown products, require that the barrel, screw, and other

parts which directly contact the material be corrosion resistant. Among these are vinyls and vinylidenes.

Auxiliary equipment

PT's Comparative Data lists information on the following types of heaters: electrical resistance, steam and hot oil-jacketed, and the more recent electric induction heater. Resistance heating is still the most popular method, since it contains the simplest units and is easiest to install. Fluid heating offers advantages, however. Heat can be supplied more uniformly and with lower local temperatures than by other means; therefore, hot spots can be avoided. Further, a liquid system can absorb as well as supply heat, making cooling easier. The other systems use air blowers with or without cooling coils to remove heat from the cylinder.

When selecting any of the heating methods outlined above, careful consideration should be given to the type of instrumentation needed for controlling the cylinder temperature during extrusion. Three basic types of controllers are available: the "on-off," the proportioning type, and the saturable core. The "on-off" type is the simplest, switching off current when a signal is received from the thermocouple. The time lag in this system causes some over-riding in temperature since hysteresis action cannot be narrowed to close tolerance on a preset temperature. For example, a signal will turn off the current at 400° F., but will not turn it on until the temperature has dropped to 350° F. The proportioning-type controller adjusts the period of current flow to the heater in a cyclic manner so that it is reduced as the preset temperature is approached. This type of control reduces the probability of temperature over-ride. The saturable core reactor controller is also a proportioning type, but regulates the heat by adjusting the amperage instead of the "time-on" period. All three types have been used successfully to control heat. When extremely accurate temperature control is desired, the saturable-core controller should be used, even though it is the most costly.

An extruder hopper should be large enough to contain resin for at least an hour's operation. It consists basically of a truncated metal cone or pyramid which sits over the feed opening and directs the flow of material into the cylinder feed-pocket. Hoppers vary in size, shape, and complexity of design. The more complex units contain baffles and other means for circulating hot, dry air through the resin granules.

Many extrusion firms purchase resin in bulk and store it in huge bins. Resin is air-conveyed directly from these bins to the hoppers. Smaller, but nevertheless continuous operations require almost the same type device—an automatic hopper loading mechanism which feeds material from an adjacent drum to the hopper. In addition to labor savings, these closed-resin transport systems keep contamination and spillage to a minimum.

One very important consideration when air is used for transport or drying is that it must be free from water and oil. This may mean the addition of an oil separator, filter, and dryer to an existing air system.

Under the heading "Special Features," manufacturers list the refinements which add to their machines' serviceability. "Optional Features," on the other hand, list items available at additional cost such as cylinder vents for the removal of volatile matter during extrusion, valved heads for increasing back pressure in the cylinder and regulating resin flow, additional heat zone controls, and special undercarriages for retracting the extruder from other process equipment.

Consideration must be given to service and maintenance. This is particularly important when a machine is scheduled for continuous operation. Most machinery builders offer fast service calls and can deliver spare parts from stock; however, some do not. Each production day lost for lack of a replacement part costs plenty.

The manufacturers generally provide customers with an opportunity to view their machines in action, whether in the manufacturers' plants or in another extrusion plant. At other times, they may be on demonstration in the resin producers' laboratories. Seeing a machine in operation affords a better understanding of the equipment than any amount of descriptive literature.

Conclusions

Advanced planning, with thought given to location, flexibility or versatility, maintenance, safety, and what must be accomplished by the extruder, will result in an efficient production set-up.

—The End

Fixed-orifice pressure control for extruders

(Continued from page 44)

Extrusion rates in the range of 25-105 lbs./hr. were measured. These are plotted in Figure 8 against the pressure drop across the orifice, together with curves calculated from Figures 3, 4, and 6. The agreement between observed and calculated results is considered quite good.

Precaution

A potential danger exists in the use of small-diameter orifices where foreign matter could block the orifice and cause excessive pressure build-up in the head of the extruder. Bernhardt (2) has described a simple rupture disk assembly which is installed and replaced easily, and which provides effective pressure release in such an eventuality. This, or an equivalent pressure relief system, is recommended wherever high head pressures are anticipated or possible.

Bibliography

(1). "Processing of Thermoplastic Materials." Published by Reinhold Publishing Corp., New York, N. Y. (1959).

(2). E. C. Bernhardt, "Stock Thermocouples, Pressure Gauges and Rupture Disks for Use on Plastic Extruders." SPE J., 11, 6 (June 1955).

PT's Comparative Data on 1960 Extrusion Machines

(Based on data submitted by the machine manufacturers)

	Aetna-Standard#						Battenfeld			
Manufacturer*										
Machine model	IM15-20PH-500*	IM25-20PT-150**	IM25-24PH-500*	IM35-24PH-500*	IM45-24PH-500*	IM60-24PH-500*	BE-20 0.78"	BE-40 1.57"	BE-60 2.36"	BE-90 3.54"
Screw: Number	One	One	One	One	One	One	One	One	One	One
Design type	To meet application & resin or to customer's special requirements. →						Various design & compression ratios, as required.			
Effective length, inches	30	50	63½	85	108	144	- - -	- - -	- - -	- - -
L/D ratio, excluding feed opening	20:1	20:1	25.4:1	24.3:1	24:1	24:1	20:1	20:1	24:1	24:1
Speed range, rpm.	25-197	10-75	10-150	10-150	10-150	10-128	8-88	9-65	8-60	7-54
Materials (base & surfacing): Screw	Alloy steel, screw flights flame-hardened, chrome-plated. →						Hard chrome-plated machine steel. →			
Cylinder	Alloy steel tubing with Xaloy or Xaloy 306 lining. →						Nitrided steel. →			
Feed opening size, inches	1-3/8 x 2	2½ dia.	2½ x 3	3½ x 5	4-3/4 x 6	5-7/8 x 9	Same as screw diameter. →			
Gear reduction type	Single-reduction helical.	Double-reduction herringbone type. →					Spur gearing. →			
Thrust carrier: Type	Tapered roller. Radial thrust. →			Tapered roller. Flat thrust. →	Cylindrical roller →		Ball thrust bearing, roller bearing for radial seating. →			
B-10 service life,** hrs. @ 100 rpm. & 5,000 psi. pressure	67,500	10,000	145,000	110,000	110,000	58,500	2,500#	2,500#	2,500#	2,500#
Extrusion cylinder: Number of heating zones	3	3 ###	5 #	5 #	5 #	6 ###	2;2##	3;3##	3;4##	4;4##
Max. kw. demand on cylinder	6.3	10.5	15	29	58.6	93.6	3;*	5;*	10;*	20;*
Lubricating system	Dip and splash. →						Oil bath.			
Drive motor, hp.	7.5	20-40	25-40	50-75	125-150	200-300	3	5	10	20
Extrusion capacity, lbs./hr., based on polyethylene (mol.wt. 20,000, melt index 4.0, sp.gr. 0.92) @ 500 ± 10° F. with output rate held to ± 15%	75-100	75-100	150-220	300-400	600-700	1,000-1,200	15**	75**	152**	300**
Approx. heat-up time, minutes, for room temp. to 500° F. (for polyethylene above).	20***	25 ***	30***	40***	50***	60***	30	30	60	60
Heaters: Type	Induction coils. →						Resistance heater bands. →			
Controls	Three-position, proportioning, with thermocouple break protection 0-800° F. →						Thermostat. →			
Special features (included as standard)	Portable. (See other models)	Thrust capacity up to 5,000 psi.	Thrust capacity up to 10,000 psi. Auto.water cooling. Screw-adjusting mechanism to vary internal press. without stopping. Leak-proof, quick-opening, b-p head. Close temp.control up to 800° F. Base designed to accommodate coating dies. Stock-press. gauge upstream from valve. →				Push-button screw speed change. Extruder & control panel as one integral unit. Dismantling of screw towards the rear of machine. →			
Optional features (avail. at extra cost)	Special carriage for retraction of extruder. Drive selection. Special feed hoppers. Induction heated film & coating dies. Overhead die supports. Pressure transducers. Power factor correction. Special recorders. →						Cored screw for fluid heating & cooling. Proportional timers for temperature control. →			
Approx. floor space (LxW), feet	5-2/3 x 2½	8 x 5	12½ x 6	17 x 6	20 x 7	20 x 7	3 x 2½	4 x 2½	6½ x 3	10½ x 3-1/3
Approx. delivery time, weeks***	Varies from 8-20 weeks. →						12	12	12	12

\# Includes one zone.
With booster heater on head.
Plus one resistance-heater on head.
\# Induction heated, high pressure (10,000 psi.) 500 line extruders.
** Induction heated, low pressure (5,000 psi.) 150 line extruders.
*** Includes normal soaking time for cold polyethylene, starting with a cold extruder. 50% less time for an empty extruder.

\# Approximate.
On extruder; on head.
* Kw. on extruder; kw. on head according to requirements.
** Max. output of polyethylene.

* Complete company names and addresses are as follows:

Aetna-Standard Div., Blaw-Knox Co., Engineered and sold by Hale and Kullgren, Inc., 613 E. Tallmadge Ave., Akron 9, Ohio
Battenfeld Corp. of America, 959 W. Grace St., Chicago 13, Ill.
Chandler Equipment Engineering Corp., 153 S. Zeyn St., Anaheim, Calif.
Davis-Standard, Div. of Franklin Research Corp., Mystic, Conn.
Frank W. Egan & Co., South Adamsville Rd., Somerville, N. J.
Farrel-Birmingham Co., Inc., Inductomatic Extruder Div., Ansonia, Conn.
Johann Fischer extruders, made in West Germany, are sold in U.S.A. by Barclay Industries, Inc., 420 Lexington Ave., New York 17, N. Y.
Hartig Extruders (see Waldron-Hartig)
Killion Tool & Mfg. Co., 56 Depot Street, Verona, N. J.
Luigi Bandera extruders are made by Covema in Italy and sold in U.S.A. by The Rainville Co., Inc., 839 Stewart Ave., Garden City, L.I., N. Y.
Mapre extruders, made in France, are sold in U.S.A. by Reed-Prentice, Div. of Package Machinery Co., East Longmeadow, Mass.
Modern Plastic Machinery Corp., 64 Lakeview Ave., Clifton, N. J.
National Rubber Machinery Co., 47 West Exchange St., Akron 8, Ohio
Negri Bossi extruders, made in Italy, are sold in U.S.A. by Acme Machinery Mfg. Co., Inc., 20 South Broadway, Yonkers, N. Y.
Olympia Tool and Machine Co., 119-121 Delancy Street, Newark 5, N. J.
Prodex Corp., King George Post Road, Fords, N. J.
Reifenhauser extruders, made in Germany, are sold in U.S.A. by Heinrich Equipment Corp., 111 Eighth Ave., New York 11, N. Y.
John Royle & Sons, 10 Essex Street, Paterson 3, N. J.
Sterling Extruder Corp., 1112 Baltimore Avenue, Linden, N. J.
Waldron-Hartig Div., Midland-Ross Corp., P.O. Box 531, Westfield, N. J.
Welding Engineers, Inc., Norristown, Pennsylvania
Werner & Pfleiderer Corp., 500 Fifth Ave., New York 36, N. Y.

** Life expectancy of 90% of all bearings.

*** Delivery time, as well as prices, should be substantiated in a formal quotation from the manufacturer.

\# Has more machine types or sizes, in addition to tabulated models.

	Battenfeld (Cont'd.)		Chandler	Davis-Standard#					
Manufacturer*									
Machine model	BE-120	BE-150	1", 1½", 2", 2½", 3½"	Model 15T	Model 25T	Model 35T	Model 45T	Model 60T	Model 80T
Screw: Number	4.72"	5.90"	One	1½"	2½"	3½"	4½"	6"	8"
Design type	One	One	To customers' specs.	One	One	One	One	One	One
	(See 1st page)			To customers' specifications. →					
Effective length, inches	- - -	- - -	- - -	(15:1) 21½ to 122-1/8; (20:1) 30 to 160. →					
L/D ratio, excluding feed opening	24:1	24:1	20:1 & 24:1	15:1, 20:1, or to customers' specifications. →					
Speed range, rpm.	6-38	6-38	25 - 250	Up to 400	200	150	110	85	60
Materials (base & surfacing): Screw	(See 1st page)		Nitralloy	Alloy steel hardened and polished. →					
Cylinder	" " "		Xaloy or Xaloy 306	One-piece with Xaloy or Xaloy 306 liner. →					
Feed opening size, inches	" " "		1½,2,2½,3½	Matched to hopper size. →					
Gear reduction type	" " "		Chain; chain & gear on 3½" size.	Direct drive.	Helical →				Herringbone
Thrust carrier: Type	" " "		Roller type	Roller bearing. →					
B-10 service life,** (see 1st pg.)	2,500#	2,500#	- - -	176,000	165,000	50,400	90,000	50,400	39,300
Extrusion cylinder:									
Number of heating zones	5;6##	5;6##	2 on 1½"; 3 on 2"-3½"	2,3	3,4	3,4	3,4	3,4	3,4
Max. kw. demand on cylinder	25;*	35	- - -	9	20	28	40	56	80
Lubricating system	(See 1st page)		Reservoir type	Gravity feed	Oil pump. →				
Drive motor, hp.	25	100	5;10;15;25	25	60	100	150	200	300
Extrusion capacity, lbs./hr. (see 1st pg.)	570**	950**	—;110;160;225;450	100	200	400	600	900	1,500
Approx. heat-up time, min., (see 1st pg.)	90	90	—;20;30;45	15	15	25	30	40*	60*
Heaters: Type	(See 1st page)		Band type	Therma-fin electric. →					
Controls	" " "		Proportioning	Proportioning controllers for each heat zone. →					
Special features (included as standard)	" " "		Tachometer; air-blast cooling; shut-off & indicator on hopper; completely wired; drive motor built in.	Pre-wired control panel. Separate thrust & radial bearings. Water cooled feed section. Stainless-steel hopper with shut-off & level indic. Screw flights extend back beyond feed throat. One-piece cyl. H-d head clamp. Belt drive from motor. Removable feed throat bushing. →					
Optional features (available at extra cost)	" " "		- - -	L/D ratios & screw designs to order. Cored or solid screws. Heads to order, with or without electric heating. Valved heads. →					
Approx. floor space (LxW), feet	12½x 4-2/3	18x4-2/3	5 x 2½	4½ x 2	7 x 2	9 x 2½	12 x 3	15 x 3½	20 x 4½
Approx. delivery time, weeks***	12	12	4 - 8	8 - 14	8 - 14	8 - 14	8 - 14	8 - 14	8 - 14

Footnotes:
See 1st page.

* Have 2 Therma-Fins, 2 blowers, & 2 sealing dampers in each heat zone.

	Egan#						Farrel-Birmingham#			
Manufacturer*										
Machine model	2	2½	3##	4½##	6#	8#	2½"	4½"	6"	13 x 8½"
Screw: Number	One	One	One	One	One	One	One	One	One	One
Design type	As required, depending on application.						Constant-pitch or to customers' specs. →		Metering or full-flighted.	Hot feed, full-flighted.
Effective length, inches	40	60	84	108	144	192	50	90	60-120	54
L/D ratio, excluding feed opening	20:1,24:1	20:1, 24:1, 32:1 →					16:1,20:1	16:1,20:1	10:1	5:1
Speed range, rpm.	As required, depending on application. →						Up to 200	5-90	10-100	4-40
Materials (base & surfacing): Screw	Steel, with flights & surfaces chrome-plated, stellited, nitrided, or prehardened. →						Alloy steel →		Alloy steel with stellited thread tips. →	
Cylinder	One-piece heat-treated alloy steel with Xaloy or Xaloy 206 liner. →						Xaloy or Xaloy 306 →		Nesbanite, cast steel or welded steel with Xaloy liners. →	
Feed opening size, inches	As required, depending on application. →						2½	4½ dia.	To suit material.	To take batch from Banbury.
Gear reduction type	Herringbone. →						Helical	Herring-bone	Double-reduction herring-bone. →	
Thrust carrier: Type	Roller thrust. →						Tapered or flat roller. →		Flat roller. →	
B-10 service life,** (see 1st pg.)	200,000	320,000	200,000	200,000	200,000	192,000	77,500#	20,500#	Five-year minimum life.	
Extrusion cylinder:										
Number of heating zones	2	4	4	4 or 5	4 or 5	4 or 5	2 or 3	3 or 4	Depends on number of cylinder sections. →	
Max. kw. demand on cylinder	16	28	42	72	160	240	13.5	33.6	- - -	- - -
Lubricating system	Continuous forced feed. →						Immersion →		Pump and splash. →	
Drive motor, hp.	10 - 15	15 - 30	25 - 50	50-150	75 - 250	100-300	20##	60##	60-125##	50-125##
Extrusion capacity, lbs./hr. etc. (1st pg.)	40 - 90	75 - 180	120 - 320	250-600	400-1,000	800-2,000	100-150	300-450	1,000	3,000
Approx. heat-up time, min., etc. (1st pg.)	30	30	30	30	30	30	20	45	- - -	- - -
Heaters: Type	Ceramic	Ceramic	Ceramic	Ceramic	Ceramic	Ceramic	Induction	Induction	Induction, steam or	Steam, oil, or Dowtherm.
Controls	Proportioning type. →						Automatic →		oil. Manual or automatic. →	
Special features (included as standard)	Pre-wired control panel. Pre-wired heater bands & thermocouples. Common piping for water & drain lines. Cut-off slide, sight glass & emptying chute on hopper. Breaker plate, head clamp, safety guards. →						Induction heating → Forced-air cooling →		Central control panel. Can be regulated to Banbury discharge cycle. Pneumatic hopper ram. →	
Optional features (avail. at extra cost)	Screw-speed indic. Back-press. gage. Melt-temp. indic. assembly. Screw extractors. Heater burn-out lights. Motor-load indicators. Pneu. head clamps. Adaptor with cartridge-type filters. Stepless temp. controller. Timers for preheating cylinders, Calrod, induc.-type, or thermostrip heaters. Var.-pitch flights & torpedo patterns. Cylinder cooling by direct air. Willert temperature control system. →						Other L/D ratios. →		One additional die heat zone control. Other L/D ratios. Melt-temp. indic. Var. dies. Hydraulic breechblock. Hydr. or manual "C" clamp. Vented cylinders and special screw types. →	
Approx. floor space (LxW), feet	8 x 4	11 x 4	13 x 5	15 x 7	17 x 8	19 x 9	6 x 2	12 x 4	12x4-2/3	10-3/4x6-3/4
Approx. delivery time, weeks***	2	2	4	8	10	12	6	10	20 and up →	

\# Heavy-duty, high-pressure designs.

\# Minimum. Average life is five times minimum.
At 1.5 S.F.

	Farrel-Birmingham# (Cont'd.)		Johann Fischer#						Hartig	
Manufacturer*										
Machine model	6½"	12"	JFP 45/20D 1-3/4"	JFP 50/15D 2"	JFP 60/15D 2-1/4"	JFP 60/20D 2-1/4"	JFP 60/25D 2-1/4"	JFP 90/20D 3-1/2"	15T20 1½"	25T20 2½"
Screw: Number	One	One	One	One	One	One	One	One	One	One
Design type	Cold feed, metering.		Six standard types to suit all materials.						Various design types & compr. ratios, as req'd.	
Effective length, inches	168	144-264	35	30	35	47	59	70	30	50
L/D ratio, excluding feed opening	To suit material.		20:1	15:1	15:1	20:1	25:1	20:1	20:1*	20:1*
Speed range, rpm	8-80	8-75	18-81	18-81	16-72	18-67	18-67	18-67	25-165*	22-130*
Materials (base & surfacing): Screw	(See preceding pg.)		Nitrided steel.						Heat-treated alloy steel with flame-hardened flights.	
Cylinder	(" " ")		"						Steel with Xaloy or Xaloy 306 integral lining.	
Feed opening size, inches	To suit material.		Same as screw diameter.						2 x 3	3 x 4
Gear reduction type	(See preceding pg.)		Spur gearing.						Herringbone gear type.	
Thrust carrier: Type	Flat roller.		Roller thrust.						Tapered roller.	Cylindrical roller.
B-10 service life,** (see 1st pg.)	(See preceding pg.)		30T*	30T*	30T*	45T*	65T*	85T*	30,000	65,000**
			Minumum 5 years under normal use.							
Extrusion cylinder:										
Number of heating zones	(" " ")		3	3	3	3	3	3	2	3
Max. kw. demand on cylinder	- - -	- - -	3.9	3.9	3.9	7.5	9.0	25.5	9	15
Lubricating system	Pump & splash.		Oil bath	Oil bath	Oil bath	Oil bath	Oil bath	Oil bath	Oil bath	Recirculating oil bath type.
Drive motor, hp.	100-300##	100-600##	7.5	7.5	10	20	30	41	7½ - 10	20 - 40
Extrusion capacity, lbs./hr., etc.	1,500	3,000	18 - 77	13 - 66	22 - 88	11 - 154	44 - 220	77 - 330	56#	150#
Approx. heat-up time, minutes	- - -	- - -	20	30	30	45	60	60	25 min.	30 min.
Heaters: Type	(See preceding pg.)		Induction heating bands.						Cast aluminum.	
Controls	Manual or auto.		Proportioning type or others if specified.						Anticipating or proportioning pyrometer.	
Special features (#included as standard)	(See preceding pg.)		Push-button screw speed control; pre-wired control panel; water-cooled feed section; water cooling to heating zones; steel hopper with shut-off and level indic. tiltable for easy unloading; pre-wired heater bands & thermocouples; breaker plate; screw speed indic.; ammeters for drive motor and each temp. regulator.						Torque-resisting barrel support. Air and/or water cooling. Prewired & manifolded temp. control system.	
Optional features (avail. at extra cost)	(See preceding pg.)		Air cooling and auto. controls; heads for vert., horiz., or slow molding available; cored or solid screws.						Vent, valving, quick-change breaker & plate. Complete line of heads & adaptors.	
Approx. floor space (LxW), feet	27 x 7	25x7½ to 40 x 9	5-2/3 x 2 3½x1-1/3**	5-2/3 x 2 3½x1-1/3**	5-2/3 x 2 3½x1-1/3**	8½x2-1/6 3-1/3 x 1-1/3**	10 x 2½ 3-1/3 x 1-1/3**	11 x 3 1x1-2/3**	5 x 4	5½ x 5
Approx. delivery time, weeks***	20 and up		6 - 8	6 - 8	6 - 8	8 - 12	8 - 12	8 - 12	- - -	- - -

Footnotes: See Preceding page.

* Dynamic Load
** Control Cabinet

Footnotes: See below

	Hartig (Cont'd.)				Killion					
Manufacturer*										
Machine model	35T20 3½"	45T20 4½"	60T20 6"	80T20 8"	3/4" Lab.	1" Lab.	1½" Lab.	1½" Lab.	2½" Lab.	3½" Lab.
Screw: Number	One	One	One	One	One	One	One	One	One	One
Design type	(See above)				To suit material.					
Effective length, inches	70	90	120	160	15	20	25	30	50	70
L/D ratio, excluding feed opening	20:1*	20:1*	20:1*	20:1*	20:1	20:1	20:1	20:1	20:1	20:1
Speed range, rpm.	11-110*	9.7-97*	8-80*	7-70*	10-100	15-150	12-96	12-96	10-80	8-75
Materials (base & surfacing): Screw	(See above)				Flame-hardened alloy or stainless steel.					
Cylinder	" "				Stainless steel.	Stainless steel or Xaloy liner.				
Feed opening size, inches	4x5-5/8	5 x 7	7 x 9	8-3/4 x 12-1/4	3/4 x 1½	1 x 1½	1½ x 2	1½ x 2	2½ x 3½	3½ x 5½
Gear reduction type	Herringbone gear type.				Variable drive.			Herringbone type.		
Thrust carrier: Type	Cylindrical roller.				Radial thrust ball bearing.			Roller bearing.		
B-10 service life,** (see 1st pg.)	36,000**	17,000**	17,900**	20,000**	25,000	25,000	60,000	60,000	180,000	195,000
Extrusion cylinder:										
Number of heating zones	3	4	4	5	2	2	2 or 3	3	3	3 or 4
Max. kw. demand on cylinder	27	46	76	120	1.5	1.8	2.4	3	18	24
Lubricating system	(See above)				Splash from housing.			Splash or pump.		
Drive motor, hp.	40 - 75	60 - 100	100-150	200-250	¾	¾	3	3 or 5	10	25
Extrusion capacity, lbs./hr.	294#	485#	865#	1,535#	6 - 7	12 - 16	25	30 - 35	100	175
Approx. heat-up time, minutes	30 min.	35 min.	35 min.	40 min.	15	20	20	20	30	30
Heaters: Type	Cast aluminum.				Electric band-type.					
Controls	(See above)				Optional	Optional	Proportioning type.			
Special features (included as standard)	(See above)				- - -	- - -	- - -	- - -	- - -	- - -
Optional features (avail. at extra cost)	(See above)				Special barrel lengths, screws, and dies.					
Approx. floor space (LxW), feet	9½ x 6	9 x 7	13 x 7½	15 x 8½	4 x 2	4 x 2	5 x 3	5 x 3	8 x 3	9 x 3
Approx. delivery time, weeks ***	- - -	- - -	- - -	- - -	2	2	6	6	8	8

* Other screw speeds & L/D ratios available.
** Tandem bearings available for 10,000 psi. operation.
# Nominal.

	Luigi Bandera	Mapre			MPM					
Manufacturer*										
Machine model	TRS 30 to TRS 200 (1-1/8" to 7-3/4")	2½"	3-5/8"	4"	1½"	2½"	3½"	4½"	6"	8"
Screw: Number	One	Two	Two	Two	One	One	One	One	One	One
Design type	For all thermo-plastics	Various types available. →			Four standard design types available; others to customers' orders. →					
Effective length, inches		25½	38	41	30	50	70	90	120	160
L/D ratio, excluding feed opening	20:1(Std.)	10:1	9.5:1	10:1	20:1	20:1	20:1	20:1	20:1	20:1
Speed range, rpm.	To 100	0-50	8-36	0-50	16-113	10-200	20-150	20-110	6-76	8-72
Materials (base & surfacing): Screw	Hardened & ground nickel-chrome alloy.	Hardened chrome-nickel steel. →			4140 steel, flame hardened lands, chrome-plated. →					
Cylinder	"	Hardened chrome-nickel steel. →			Xaloy or Xaloy 306 liner. →					
Feed opening size, inches	- - -	- - -	- - -	- - -	1½ x 3	2½	3½	4½	6	8
Gear reduction type	Herring-bone	Double-reduction helical gears. →			Silent chain	Herringbone type. →				
Thrust carrier: Type	Spherical roller	Tapered roller bearing. →			Roller thrust. →					
B-10 service life,** (see 1st pg.)	- - -	- - -	- - -	- - -	82,000	168,000	261,000	155,000	216,000	42,000
Extrusion cylinder:										
Number of heating zones	3 to 4	3	3	4	2	4	4	5	5	6
Max. kw. demand on cylinder	- - -	7	7.5	11	6.2	13.2	26.4	42.5	62.0	125.0
Lubricating system	Oil bath	Oil bath and splash. →			Submerged dip. →					
Drive motor, hp.	2 to 150	13.6	15	23.8	5	20-25	30-40	75-100	125-150	200-300
Extrusion capacity, lbs./hr., etc.	15 to 1,200	220	330	550	25-35	200	385	600	900	1,600
Approx. heat-up time, minutes	20 to 60	- - -	- - -	- - -	35-40	35-40	35-40	35-40	35-40	35-40
Heaters: Type	Mica insul-ation type	Resistance type. →			Cast-in band or induction heaters. →					
Controls	Stabili-matic or proportion-ing.	Auto.	Auto.	Auto.	Proportioning type. →					
Special features (included as standard)	6 gear speeds, pre-wired as-sembly.	Push-button operation & control. Hydr. power trans. Auto.-con-trolled heating zones. Separate controls for water, oil or air cooling zones on barrel. →			Tachometers. Ammeters. Melt thermocouples. Pressure gages. →					
Optional features (avail. at extra cost)	Venting	Removal of moisture & gases. Full length bored screws for heating or air cooling. Special die heads. Complete granulating equipment.			Hydraulic pressure system for controlling & valving pressure in extruder by moving screw. →					
Approx. floor space (LxW), feet	- - -	6 x 2½	6½ x 4	9-1/3 x 3	4 x 7	4 x 10	4 x 12	5 x 15	5 x 18	6 x 22
Approx. delivery time, weeks***	In stock in N.Y.	12 - 24	12 - 24	12 - 24	6 - 8	8	8	10	12	16

	NRM						Negri Bossi			
Manufacturer*										
Machine model	Model 55 (1-1/2")	Vanguard II (2-1/2")	Vanguard III (3-1/2")	Pacemaker (3-1/2")	Pacemaker (4-1/2")	Pacemaker (6")	NB 90 Master	NB 45 Master	NBV 60 Master	NBV 75 Master
Screw: Number	Single	Single	Single	Single	Single	Single	One	One	One	One
Design type	Six standard designs. →						- - -	- - -	- - -	- - -
Effective length, inches	30"	50"	69½"	69½"	89-1/16"	118-3/4"	18:1	18:1	18:1	18:1
L/D ratio, excluding feed opening	20:1	20:1, 24:1	20:1 →				6	15-60	15-60	15-60
Speed range, rpm.	12-80	5-180	5-160	10-130	10-120	10-100	- - -	- - -	- - -	- - -
Materials (base & surfacing): Screw	Chrome-plated alloy steel, surface-hardened flight lands. →						- - -	- - -	- - -	- - -
Cylinder	One-piece steel with cast-in Xaloy 306 liner. →						- - -	- - -	- - -	- - -
Feed opening size, inches	1½ x 3	2½ dia. std.	3½ dia. std.	3½ dia. std.	4½ dia. std.	6 dia. std.	- - -	- - -	- - -	- - -
Gear reduction type	Roller chain	Worm	Worm	Helical	Helical	Helical	- - -	- - -	- - -	- - -
Thrust carrier: Type	Ball	Roller	Roller	Roller	Roller	Roller	- - -	- - -	- - -	- - -
B-10 service life,** (see 1st pg.)	500 min.#	212,500	61,000	61,000	75,000	55,000	- - -	- - -	- - -	- - -
	2,500 ave.	std.	std.	std.**	std.***	std.##				
Extrusion cylinder:										
Number of heating zones	2	4	4	4	5	5	5	5	5	5
Max. kw. demand on cylinder	5.1	13.75	25.8	25.8	38.5	62	12	3.5	6	8.5
Lubricating system	Automatic.						Splash	Splash	Splash	Splash
Drive motor, hp.	5	10-40	25-40	25-75	50-125	100-300	22	5	8	14
Extrusion capacity, lbs./hr.	30-42*	200*	400*	400*	600*	1,000*	44-154*	6.6-64*	22-97*	44-165*
Approx. heat-up time, minutes	30	30	30	30	30	30	30	30	30	30
Heaters: Type	Cast-in	Induction or cast-in resistance. →					Resistance type.			
Controls	Proportioning type pyrometers; 3-pos. on induction machines. →						- - -	- - -	- - -	- - -
Special features (included as standard)	Prewired fabricated steel control cabinet. Quick-changing die adapter gate. Automatic cooling, air or liquid. →						Speed variator; American controls. →			
Optional features (avail. at extra cost)	Bal.heat control	Over-temp. alarms, vacuum feed, Mandi-clamp front end.					Speed gearbox. →			
		2½ x 5 feed opening	3½ x 7 feed opening.		4½ x 9 feed opening	6 x 12 feed opening				
Approx. floor space (LxW), feet	4½ x 1-2/3###	6x2###	8x2###	9x3###	11x3###	14x3½###	10 x 2½	4½ x 2½	6½ x 2½	7-2/3
Approx. delivery time, weeks	4	6	6	6	8	10	6 - 8	6 - 8	6 - 8	6 - 8

* Nominal
** Also available with double oversize thrust bearings to give B-10 service life of 405,000 hrs.
*** Also available with double oversize thrust bearings to give B-10 service life of 363,000 hrs.
# At 18,900 psi. & 40 rpm.
Also available with double oversize thrust bearings to give B-10 service life of 484,000 hrs.
Not including electrical control cabinet.

* Nominal output, lbs./hr.

	Olympia					Prodex			
Manufacturer*									
Machine model	1½	2½	3½	4½	6	1-3/4	2½	3½	4½
Screw: Number	One	One	One	One	One	One	One	One	One
Design type	Various designs available to suit applications.					Metering.			
Effective length, inches	33	53	70	90	126	35;42	50;60	70;84	90;106
L/D ratio, excluding feed opening	20 to 1	20 to 1	20 to 1	20 to 1	20 to 1	20:1, 24:1	30:1		
Speed range, rpm.	25-175	20-130	20-110	10-85	0-75	20-250	20-225	20-140	20-120
Materials (base and surfacing): Screw	Stellite-tipped or flame-hardened flights. Chrome-plated.					Stellite-tipped 4140 steel.			
Cylinder	One-piece steel with integral Xaloy liner.					Xaloy.			
Feed opening size, inches	3 x 3	3 x 4	4½ x 5	6 x 6	7 x 7	2½ x 4½	3½ x 4½	4½ x 5½	6 x 7
Gear reduction type	Shaft-mounted reducer.	Herringbone gear type.				Herringbone.			
Thrust carrier: Type	Spherical roller.					Spherical roller.			
B-10 service life,** (see 1st pg.)	283,000*	191,500*	56,500*	30,000*	10,400*	220,000	150,000	105,000	97,000
Extrusion cylinder:									
Number of heating zones	2	3	4	4	5	2-3	4	4	4
Max. kw. demand on cylinder	8	15	30	45	65	7	15	35	50
Lubricating system	Force feed to thrust assembly.					Forced-feed gear pump.			
Drive motor, hp.	5	15-25	30-40	50-75	100-150	7½ - 10	20 - 40	40 - 75	60 - 150
Extrusion capacity, lbs./hr.	30-60**	90-145**	180-325**	400-550**	500-700**	100	200	400	600
Approx. heat-up time, minutes	30	40	40	40	40	30	35	35	35
Heaters: Type	Choice of Mica or Starflex.					Calrod.			
Controls	Proportioning.					Proportioning.			
Special features (included as standard)	Prewired control panel, all elec. & plumbing complete, hopper shut-off and level indic., quick-opening clamp, safety guard.					Venting valve, pressure gages, stock temperature thermocouple. Change gear reducer.			
Optional features (avail. at extra cost)	Valving, pressure gauges, vented and two-stage extrusion.					Wattmeter, tachometer.			
Approx. floor space (LxW), feet	5 x 2½	8 x 5	10 x 5	12 x 5	16 x 5	5 x 2½	8 x 3	10 x 4	12 x 4
Approx. delivery time, weeks***	4 - 6	4 - 6	6 - 8	8 - 10	12 - 14	4	8	8	8

* The dynamic load rating of the thrust bearing is in accordance with A.F.B.M.A. ratings. The figures shown represents the average life expectancy of 90% of all bearings.

** Extrusion capacity will vary depending on diameter of die opening.

	Prodex (Cont'd.)		Reifenhauser	Royle					
Manufacturer*									
Machine model	6"	8"	1¼, 1-3/4, 2½, 3½, 4½, 6	#2 (2½")	#4 (3½")	#2A (4½")	#3A (6")	#4A (8½")	#5A (10")
Screw: Number	One	One	One	One	One	One	One	One	One
Design type	Metering.		2 or 3 zone metering type.	Metering.					
Effective length, inches	120;144	160;192	- - -	60	84	90	120	127½	140
L/D ratio, excluding feed opening	20:1, 24:1,	30:1	20:1, 25:1, 30:1	24:1	24:1	20:1	20:1	15:1	14:1
Speed range, rpm.	10-100	10-100	Any range	20-200	18-180	18-180	18-180	10-100	10-100
Materials (base & surfacing): Screw	(See above)		Surface-hardened steel.	Stainless steel, hard-surfaced weld.					
Cylinder	"	"	Xaloy	Steel with removable Xaloy liner.					
Feed opening size, inches	7½ x 9	12 x 14	- - -	2½x2-3/4	4½x4-5/16	5½x4-5/16	7x7-3/8	10½x12-1/8	10½x12-1/8
Gear reduction type	(See above)		Helical or herringbone	Worm	Worm	Opposed helical.			
Thrust carrier: Type	Spherical roller.		Spherical roller.	Flat roller bearings.					
B-10 service life,** (see 1st pg.)	75,000	70,000	- - -	163,500	150,000	120,000	63,000	50,000	40,000
Extrusion cylinder:									
Number of heating zones	5	6	3 - 6	4	4	3	3	3	3
Max. kw. demand on cylinder	90	125	10 - 50	27	51	54	85	108	132
Lubricating system	(See above)		Forced auto.	Self-enclosed gravity flow with positive feed.					
Drive motor, hp.	125-200	200-400	10-250	40	75	125	200	300	400
Extrusion capacity, lbs./hr.	1,200	1,900	25-900	200	400	700	1,150	1,180	2,500
Approx. heat-up time, minutes	35	35	30-60	20	20	30	30	30	30
Heaters: Type	Calrod.		Induction resistance band.	Tubular resistance heaters.					
Controls	Proportioning.		Proportioning	Proportioning.					
Special features (included as standard)	(See above)		Built-in drive motor & elec. controls.	Safety head bolts. Common housing for gear & thrust carrier. Dual voltage control. Hi-velocity evaporating cooling. Spirod radiant heating.					
Optional features (avail. at extra cost)	(See above)		Floating screw.	Vented and 2-stage extrusion. Controlled-velocity flow. Other screw sizes, L/D ratios, and drive sizes on request.					
Approx. floor space (LxW), feet	17 x 4½	22 x 4½	- - -	7 x 2	8½ x 2½	9 x 4	13 x 4½	14 x 5	16 x 6
Approx. delivery time, weeks***	10	12	12 - 16	- - -	- - -	- - -	- - -	- - -	- - -

Sterling#

	1½"	2"	2½"	3½"	4½"	6"
Screw: Number	One	One	One	One	One	One
Design type	Plastic and metering type.					
Effective length, inches	35½	42	52½	73½	93½	126
L/D ratio, excluding feed opening	20:1	20:1	20:1	20:1	20:1	20:1
Speed range, rpm.	0-110	0-100	0-95	0-90	0-90	0-90
Materials (base & surfacing): Screw	Chrome-molybdenum steel, flame-hardened.					
Cylinder	Xaloy.					
Feed opening size, inches	1½	3	3	4	6	7
Gear reduction type	Herringbone gear reducer.					
Thrust carrier: Type	Self-aligning spherical roller thrust bearing.					
B-10 service life.** (see 1st. pg.)	#	#	#	#	#	#
Extrusion cylinder:						
Number of heating zones	2	3	3	3	4	4
Max. kw. demand on cylinder	10½	15½	22½	30	48	90
Lubricating system	Forced lubrication. Closed system for reducer & thrust bearing.					
Drive motor, hp.	3 - 10	7½ - 15	15 - 25	30 - 60	50 - 100	100-200
Extrusion capacity, lbs./hr.	55	100	150	320	600	1,000
Approx. heat-up time, minutes	25	25	25	30	35	35
Heaters: Type	Mica band, cast-in alum. Calrod, thermastrip.					
Controls	Proportioning or saturable core reactor controls.					
Special features (included as standard)	Water/steam barrel cooling or air cooling. Clamp-type closure or swing bolts.					
Optional features (avail. at extra cost)	Pressure gages. Melt thermocouples. Tachometers. L/D ratios of 15:1, 24:1, and 30:1. Vented extruders, valves.					
Approx. floor space (LxW), feet	3½ x 3	5 x 4½	5½ x 4½	7 x 5	10 x 5	14 x 6
Approx. delivery time, weeks***	3 - 4	3 - 4	3 - 4	6	6 - 8	10

Several thrust bearing assemblies available for each extruder size with minimum life of 16,000 hrs. and average life of 80,000 hrs.

Werner & Pfleiderer#

	ZSK 83/1100 (3¼")	ZSK 120/1500 (4-3/4")	PK 100/V (12/4-3/4")
Screw: Number	Two	Two	Three
Design type	Interchangeable screw sleeves and kneading disks.		Milling cone
Effective length, inches	41.4	59	- - -
L/D ratio, excluding feed opening	12.7:1	12.5:1	- - -
Speed range, rpm.	150 max.	130 max.	62 max.
Materials (base & surfacing): Screw	Nitrided steel.		- - -
Cylinder	Nitrided steel.		- - -
Feed opening size, inches	6.5	9.5	4
Gear reduction type	Herringbone spur gear.		- - -
Thrust carrier: Type	Roller bearings.		
B-10 service life.** (see 1st. pg.)	100,000	150,000	100,000
Extrusion cylinder:			
Number of heating zones	4	4	one
Max. kw. demand on cylinder	24	52	6
Lubricating system	Pump spray.		Forced lub.
Drive motor, hp.	65	200	30
Extrusion capacity, lbs./hr.	500	1,700	500*
Approx. heat-up time, minutes	45	60	45
Heaters: Type	Cast-in tubular or jacketed.		Ceramic or jacketed.
Controls	Thermostat	Thermostat	Thermostat
Special features (included as standard)	For removal of volatiles & dispersion of pigments. 3-vent ports on 3 enforced decompression sections. All screws & barrel surfaces self-cleaning.		Twin screws feed PVC blend between stationary and rotating cone.
Optional features (avail. at extra cost)	Melt-feed section. Strand dies. Face-cutting unit. Various variable speed drives. Explosion-proof construction. Also made in a shorter version.		Mounting carriage. Screw-pulling device.
Approx. floor space (LxW), feet	9 x 2½	14 x 4	10 x 4
Approx. delivery time, weeks***	26	26	26

* With flexible PVC.

Welding Engineers

	2" Special	2" 2052 VI	2.8" 2852 VI	3½" HM3500 DX	4½" HM4552 VI	6" 6052 HV2
Screw: Number	Two	Two	Two	Two	Two	Two
Design type	Full-flighted, metering, or special types.					
Effective length, inches	30 - 84	50	70	147	112½	150
L/D ratio, excluding feed opening	25 - 42	25	25	20	25	25
Speed range, rpm.	150 max.	150 max.	150 max.	150 max.	190 max.	150 max.
Materials (base & surfacing): Screw	Stellited stainless steel.					
Cylinder	Xaloy 306.					
Feed opening size, inches	3½	3½	5	6	8	10
Gear reduction type	Spur gear.		Planetary.			
Thrust carrier: Type	Ball bearing.		Spherical roller bearing.			
B-10 service life,** (see 1st pg.)	80,000##	80,000##	100,000##	120,000##	160,000###	160,000###
Extrusion cylinder:						
Number of heating zones	5 - 8	6	6	5	6	6
Max. kw. demand on cylinder	20	14	28	56	56	152
Lubricating system	Splash type.		Forced lubrication.			
Drive motor, hp.	10	10	25	100	150	300
Extrusion capacity, lbs./hr., etc.	125*	125*	300*	1,000*	1,000*	2,000*
Approx. heat-up time, minutes	45	45	60	75	75	90
Heaters: Type	Hot oil circulation.					
Controls	Thermostat.					
Special features (included as standard)	Compounder-Extractor-Extruder.					
	Lab.test unit. Can be assembled for various barrel lengths & types.	Small vent lab. or production unit.	Small vent unit.		Large vent unit. Adjustable pressure treatment.	
Optional features (avail. at extra cost)	All types of variable-speed drives, explosion-proof construction, quick-opening dies, screening heads, strand dies, pelletizing systems, special dies and other features to meet individual requirements.					
Approx. floor space (LxW), feet	7 x 2	7 x 2	8 x 3	14 x 4	14 x 4	20 x 5
Approx. delivery time, weeks***	24	20	24	30	30	34

* When processing raw crumb feed of low-pressure polyethylene.
Service life, hrs., at 100 rpm. and 2,000 psi.
Service life, hrs., at 100 rpm. and 4,000 psi.

Blow molding processes

T. C. BROADWELL*

A recent tabulation of manufacturers of blow molding equipment in this country and abroad produced a list of over fifty. In addition, the same survey revealed that there are approximately 175 domestic plastic fabricators using the blow molding process in one or more of its many forms. This marks a phenomenal growth when one considers that as recently as 1957, there were only six domestic fabricators doing blow molding.

Blow molding is not a new concept, however, since known practice and patent literature dates back to the 1930's. Work in these early stages was confined to such plastics as the cellulosics, and all equipment was developed on a custom basis. The 1940's and early 1950's saw the development of the polyethylene squeeze bottles. Although applications grew appreciably, growth in the number of fabricators was limited. The last four years marks the development of commercially available blow molding equipment which has been marketed under licensing arrangements with respect to existing patents, circumvented present patents through new design principles, or utilized design features of patents which have begun to expire.

Equipment

The approximately fifty manufacturers of equipment now in existence produce machines employing practically all of the basic principles of blow molding as we know them today. Although there are perhaps six or eight basic concepts of operation to consider in the choice of blow molding equipment, the modifications and innovations made continuously by the manufacturers present the plastics engineer with a challenging task in selecting the equipment best suited to his needs.

Injection Blow Molding

This technique involves the preforming of a parison with the use of an injection molding machine and transferring it to the blow molding station to be blown, cooled, and ejected. Material is molded around a core pin which serves as the blowing mandrel.

Within certain size limitations, it is possible to house both the injection and the blowing mold between the platens. Automatic transfer of the parison through the use of proper timing mechanisms involves a minimum of direct labor.

The principal advantage offered by the injection-blow molding technique is that parts may be formed without the need for post-finishing. For example, in the manufacture of polyethylene bottles, the finish or threaded neck of the bottle can be molded into the parison during the injection step. Also, the parison is formed with a closed end, producing a bottle with no pinched off waste at the bottom and no reaming or other finishing to be done on the neck. Further, it is possible to vary the wall thickness during the molding of the parison thus providing more uniform distribution of material in the blown part.

In some cases the advantages offered by injection molding the parison may not be needed. Therefore, the molding machine is used simply in a plasticizing capacity, with the parison being injection-extruded between the halves of the blowing mold without first having been performed in an injection mold. Disadvantages of this technique are largely economical. Since both injection and blow molds are needed for most installations of this nature, tooling costs would be higher than for a similar item produced via the extrusion-blow molding method.

Intermittent Extrusion — Fixed Mold

Here, the full capacity of the extrusion machine is not utilized and, therefore, only limited use of such a process would be practical. Cycle time and direct labor costs are high; however, it may be practical for short developmental runs and laboratory work.

Conventional extruders can be used with this method, together with the fixed blow mold which is located immediately beneath the extrusion die. The parison is extruded vertically downward between the mold halves and, when the proper length of material has been extruded, the extruder screw stops and the mold closes. After blowing and cooling—the mold opens, the part is ejected, and the cycle is repeated.

Continuous Extrusion — Rising or Sliding Molds

This method employs the basic extrusion technique as outlined above. However, the cycle time is appreciably lowered and, as a result, production rates corre-

* Plastics Technical Service, The Dow Chemical Co., Midland, Michigan

spondingly increase. This is accomplished through the rapid indexing of molds either vertically downward after clamping on the parison or horizontally to either side.

In the case of vertical mold movement, the parison is extruded in customary fashion between the open mold halves. When the proper parison length is reached —the mold closes, the parison is severed at the die, and the mold indexes rapidly downward to a fixed position beneath the extrusion die. During the downward movement, the part is blown, cooling begins, and simultaneously, the next length of parisor is extruded. At the completion of the cooling cycle, the mold opens, ejects the blown part, and automatically indexes upward to engage the parison and repeat the cycle. It is readily seen that there is a rather critical timing factor. Slight fluctuations in timing can produce parisons which are either too short or too long, thereby resulting in a reject part or one which has excessive waste.

Horizontal mold movement permits the use of multiple molds. As the parison reaches the proper length, the mold halves close, the parison is severed at the die, and the mold moves horizontally to the right or left. Another mold then indexes into position from the opposite side of the extrusion die to engage the next length of parison. As the second mold is awaiting the parison, blowing and cooling is being carried out with the first mold. This method allows a longer cooling cycle while still permitting high production rates.

Manifold Extrusion

Valved extrusion from multiple heads offers continuous operation. Parisons are extruded sequentially through an automatic valving arrangement in the manifold. Each parison is received by a properly positioned mold to complete blowing and cooling portions of the cycle.

With a two-headed manifold system, a parison is extruded from one head and, upon reaching the proper length, the manifold valve automatically diverts the flow of material to the other manifold head. The mold closes on the parison and begins blowing and cooling the part while another parison is being formed on the other side of the machine. After blowing and cooling, the mold opens, the part is ejected, and the mold is now ready to receive the next parison. The second parison has reached its proper length by this time, and once again the manifold valve diverts the flow back to the first extrusion head, repeating the cycle.

Accumulator Extrusion

Incorporating an accumulator into the blow molding line is, in a sense, combining an extrusion and injection molding operation for the purpose of forming parisons more rapidly. It is not adaptable to the rotary process, but could be used with an indexing-type table. Therefore, it should be more properly described as a variation of the plasticizing and parison delivery technique rather than as a basic concept of blow molding.

The extruder plasticizes material and feeds it to the accumulator from which the parison is formed by plunger or ram action. When a fixed level is reached in the accumulator, automatic valving stops the flow and the forward ram stroke forces material through the die orifice, forming the parison. This technique shortens the parison formation time, which is of major importance in the manufacture of very large parts. These are susceptible to excessive wall thinning due to hot stretching of the parison during extrusion.

Rotary Extrusion — Vertical and Horizontal

This involves the use of a horizontal indexing table, a horizontal continuous table, or a vertical continuous type machine.

1. The horizontal indexing table utilizes several molds mounted on a table which indexes beneath the extrusion die in a horizontal plane. As the parison is extruded one of the molds, positioned immediately beneath the die, closes on the parison severing it at the die. This mold automatically indexes to the next position for blowing, then again for cooling. The molds are mounted symmetrically on the table and, therefore, as the first mold indexes away from the extrusion die, the next mold (which has just ejected a part from the previous cycle) comes into position beneath the die and the cycle repeats.

2. The horizontal continuous table operates in similar fashion to the above method with the exception that the table operates continuously. A continuous parison is extruded horizontally rather than vertically downward and is pinched between the mold halves as they rotate past the extrusion die. As the molds continue to rotate, blowing and cooling are performed and the parts are ejected in a continuous chain.

3. The vertical continuous table action is essentially the same as the horizontal except that the rotating table is mounted in a vertical plane next to the extrusion die. The parison is extruded vertically downward and is clamped in the blowing molds as they rotate past the extrusion die.

Rotary extrusion affords high production rates since cooling does not add to cycle time. Larger extruders can be used to increase the overall output. Only applications of significant volume warrant use of this type of operation due to the relatively high initial investment, high tooling costs, and high maintenance.

Summary

The many basic processes discussed above together with the countless variations which have been developed over the past few years present the plastics engineer with a very difficult task in selecting the equipment which will best serve his needs.

It must be kept in mind that although the rotary type of blow molding machine yields very high production rates, the comparative initial investment and the relatively high tooling and maintenance costs renders it impractical unless the application is one of very high volume.

In addition to investigating the more obvious factors about a given piece of equipment such as cost, capacity, size limitations, degree of post-finishing required, etc., the engineer should pay particular attention to the matter of patent restrictions, licensing requirements, and royalties before making his decision. —THE END

PT's Comparative Data on 1960 Blow-Molding Machines

(Based on data submitted by the machine manufacturers)

Manufacturer*	Acme		Air-Formed	Atlas		Auto-Blow				
Machine model	1216A	1824A	A 250	Junior	Senior	60-B-9	155-B-7	150-B-14	450B	314
Type of preliminary operation	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion
Method of operation	Auto.	Auto.	Semi-auto.	Auto.	Auto.	Manual or automatic. →				
Number of molds	2 - 4	2 - 4	2, 4, or 8	2 - 4	2 - 8	2	4	2	2	1 or 2
Number of pieces per cycle	2 - 4	2 - 4	2, 4, or 8	2 - 4	2 - 8	2	4	2	2	1 or 2
Hopper capacity, lbs.	- - -	- - -	150	- - -	- - -	50#	50#	100#	100#	50#
Platen area, WxD, inches	12 x 16	18 x 24	19½ x 17	12 x 18	24 x 32	10 x 10*	15 x 12*	21 x 15*	30 x 26*	14 x 14*
Clamp tonnage or mold closing force, tons	6	15	2	6	24	3	5	9	25	9
Daylight opening, inches	10	Optional	12	20	30	18	14½	24	34	20
Platen stroke, inches	5	Optional	12	8½	13	9	7½	14½	16	11
Max. size of part moldable:										
Diameter, inches or WxD	9	11	11	8	12	8½	6	14	15½	11
Length, inches	36#	48#	40	40	40	30	36	45	60	42
Projected cross-section area, sq. in.	120	300	60	120	480	196	330	596	1,663	596
Dry cycle time (without cooling), min.	0.041	0.05	0.018	0.025	0.028	0.015	0.012	0.024	0.026	0.018
Output, lbs./hr., of finished parts (in polyethylene)	95	125	80	90-120	300-350	60**	100**	190**	375**	100**
Recommended preliminary machine size (also include L/D ratio for extruder, if used)	3-3½", 20:1	4",20:1	2½",20:1	2-2½", 20:1	3½", 20:1	2", 21:1	2½", 21:1	3½", 21:1	4½", 21:1	2½", 21:1
Tie bars: Number	2	3 - 4	2	2	4	2	2	2	4	2
Size, inches	1-3/4	2	1	1½	1½	1½	1-3/4#	2-1/8#	2#	1½#
Machine dimensions (LxWxH), feet	4x8½x6	4x10x6	14x7x10	7x2-1/3x4½	8x3x5-1/3	10x2x8##	10x2.5x8##	11x25x8##	12x3x9##	8x2x7##
Approx. floor space required, sq. ft.	4 x 8½	4 x 10	200	6 x 8	8 x 10	100	110	160	270	100
Approx. shipping weight, lbs.	- - -	- - -	6,000	6,000	9,000	2,000###	10,000###	11,000###	16,000###	10,000###
Special features	- - -	- - -	Finished parts do not require reaming, etc.	Ball-bearing platens. All-hydraulic operation, self-contained.		Cross-heads adaptable to use with 2,3, or 4 die heads. Air cylinder strippers. Positive hydraulic clamping. Uniform flow, self-cleaning head. →			Used with accumulator for uninterrupted extrusion. Minimum wall thickness variation. No obstruction between platens.	
Optional features avail. at extra cost	Accumulator. →		Hydr.power unit. 1-lb. injection-type cross-head nozzle.	Accumulator die. →		1-15 lb. accumulators available. Larger daylights & strokes for larger parts. Greater clamping pressures. Die heads with individual flow control. →				
Approx. delivery time, weeks	2 - 4	2 - 4	16	6 - 8	8 - 10	8	8	8	8	8

* Clear of tie bars.
** Larger or smaller capacity extruders optional.
\# Rides on gibbed ways.
Press and cross-head only.
Complete blow-molding unit.

*Complete company names and addresses are as follows:

Acme Machinery & Mfg. Co., 20 South Broadway, Yonkers, N. Y.
for Trico Mfg. Co.
Air-Formed Products Corp., Pine Street Ext., Nashua, New Hampshire
Atlas Molding Machine Corp., 257-259 Hackensack St., East Rutherford, N. J.##
Auto-Blow Corporation, 401 Bishop Avenue, Bridgeport 10, Conn.
Battenfeld Corporation of America, 959 West Grace St., Chicago 13, Ill.
Johann Fisher Co., Germany, units are sold in U.S.A. by Barclay Industries, Inc., 420 Lexington Avenue, New York 17, N. Y.
Kautex - U. S. Sales Co., Inc., 133-10 32nd Ave., Flushing 54, New York
Leedpak, Inc., 924 Fifth Avenue, New York, N. Y.
Modern Plastic Machinery Corp., 64 Lakeview Ave., Clifton, N. J.
Naslo Machinery Company, 2443 Prospect Ave., Cleveland 15, Ohio
Prodex Corp., King George Post Road, Fords, N. J.
Quality Machine Co., 3402 Third Ave., Bronx 56, N. Y.
The Rainsville Co., Inc., 657 Franklin Ave., Garden City, N. Y.
(for Kisler, S.C.A.E. and Slow-O-Matic machines).
John Royle & Sons, 10 Essex Street, Paterson 3, N. J.
F. J. Stokes Corp., 5500 Tabor Road, Philadelphia 20, Pa.
Williams, White & Co., 700 Third Avenue, Moline, Ill.
Waldron-Hartig Division, Midland-Ross Corp., P. O. Box 531, Westfield, N. J.

Has more machines in addition to tabulated models.

Atlas machines sold by Peuchen Engineering Corporation, Basin Road, P. O. Box 3164, Wilmington 4, Delaware

	Auto-Blow (Cont'd.)	Battenfeld						Fischer		
Manufacturer*										
Machine model	325	BBA 25	BBA25E	BEBA 3	BEBA 10	BEKB 10	BEKB 50	EM 50/5000	EM 5/15	EM 10/40
Type of preliminary operation, etc.	Extrusion	Injection	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion
Method of operation	Manual or auto.	Automatic,	Semi-auto.,	and Manual. →				Automatic	Automatic	Semi-auto. or auto.
Number of molds	1 or 2	One	One	One	One	One	One	1 or 2	1 or 2	1 or 2
Number of pieces per cycle	1 or 2	Multiforming possible. →						1 or 2	1 or 2	1 or 2
Hopper capacity, lbs.	100#	50#	50#	50#	50#	50#	50#	55	55	100
Platen area, W x D, inches	25 x 25*	9.8 x 16.9	50#	16.5x12.7	15.4x19.3	50#	50# 26 x 23.6	16.6x11.8	23.6x15.7	29.5x19.7
Clamp tonnage or mold closing force, tons	60	10	10	15	30	30	90	4.5	9	17
Daylight opening, inches	48	7	7	9.8	11.8	11.8	17.8	14	15.4	24
Platen stroke, inches	24	5.9	5.9	7.8	10	10	15.6	6.7	7.5	11.8
Max. size of part moldable:										
Diameter, inches or W x D	22	4	4	6	8	8	14	5.2	5.7	9.5
Length, inches	60	6	6	9.8	12.5	18	20	11	15	18.5
Projected cross-section area, sq. in.	3,993	24	24	72	128	128	280	88	180	330
Dry cycle time (without cooling), minutes	0.040	11	20	8	7	6	4	0.017	0.017	0.03
Output, lbs./hr. of finished parts (in polyethylene)	375**	16	26	44	88	88	280	120	120	240
Recommended preliminary machine size (also include L/D ratio for extruder, if used)	4½",21:1	7.3*	1.18, 24:1	1.6,22:1	2.4,22:1	2.4,20:1	3.5,20:1	2½,15:1	2½,20:1	3½,20:1
Tie bars: Number	4	2	2	4	4	4	4	4	4	4
Size, inches	2#	1.78 dia.	1.78dia.	1.57 dia.	1.97 dia.	1.97 dia.	2.56 dia.	2.5	3	3.5
Machine dimensions (L x W x H), feet	9x3x7##	5x4.5x8.3	5x4.5x8.3	5.8x4x6.1	8.9x4.15x 8.05	8.9x5.4x8.4	10.5x6.7 x9	8.3x10.5x 8.4	14.8x10.8x 9.7	15.5x14.4x 11.6
Approx. floor space required, sq. ft.	120	22.5	22.5	29	37	50	70	120	200	290
Approx. shipping weight, lbs.	14,000###	4,400	4,600	8,400	12,350	14,400	32,000	5,200	8,800	13,000
Special features	(See preceding page)	Plast. with injection cyl.	Accumulator head.	Scissor tube transport device. →		Accumulator head only, twin head possible. →		Machines deliver finished parts that do not require reaming or other secondary operations. Can be used in combination with single or double extrusion heads. →		
									Can be equipped with accumulator heads. Provide for continuous extrusion.	
Optional features avail. at extra cost	(See preceding page)	Variety of screw designs and accumulator extrusion head, larger screw. →						Can be equipped with non-corrosive components enabling their use with corrosive materials. Can be equipped with single- or multi-cavity molds. Heads & screws for working all thermoplastics.		
Approx. delivery time, weeks	8	12 - 20	12 - 20	12 - 20	12 - 20	12 - 20	12 - 20	8 - 12	8 - 12	12 - 16

(See preceding pg)

* Volume/shot, cubic inches.

	Fischer (Cont'd.)		Kautex			Leedpak	MPM			
Manufacturer*										
Machine model	EM 30/90	EM 50/350	V 3/1	G25/2	G 80/1	All-Pac	V-21	V-21-6	V-21-8	E-21
Type of preliminary operation, etc.	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Blow-forming*	Extrusion	Extrusion	Extrusion	Extrusion
Method of operation	Semi-auto. or auto.	Semi-auto.	Auto.	Semi-automatic. →		Automatic	Automatic. →			
Number of molds	1 or 2	1	1 - 3	1 - 3	1 - 3	6	2	6	8	2
Number of pieces per cycle	1 or 2	1	1 - 3	1 - 3	1 - 3	6	2	6	8	2
Hopper capacity, lbs.	100	100	- - -	- - -	- - -	Not applicable.	60 - 180	60 - 180	60 - 180	60 - 180
Platen area, W x D, inches	29.5x31.3	47 x 47	14 x 12	27 x 30	43 x 35	11 x 22	- - -	- - -	- - -	- - -
Clamp tonnage or mold closing force, tons	33	60	- - -	- - -	- - -	1.5	2	10	10	10
Daylight opening, inches	32.7	55.2	- - -	- - -	- - -	6	28	28	28	28
Platen stroke, inches	17.7	27.6	- - -	- - -	- - -	4	12	12	12	12
Max. size of part moldable:										
Diameter, inches or W x D	11.8	22	- - -	- - -	- - -	4	12	12	12	12
Length, inches	30	38	- - -	- - -	- - -	11	36	36	36	36
Projected cross-section area, sq. in.	520	1,020	- - -	- - -	- - -	44**	252	252	252	252
Dry cycle time (without cooling), minutes	0.05	0.10	0.033	0.033	0.029	0.066	3,600	3,600	3,600	3,600
Output, lbs./hr., of finished parts (in polyethylene)	240	500	88	260	260	315	220	220	220	150
Recommended preliminary machine size, etc.	3½, 20:1	4½, 20:1	- - -	- - -	- - -	Not applicable.	3½",20:1	3½",20:1	3½",20:1	2", 20:1
Tie bars: Number	4	4	- - -	- - -	- - -	None	4	4	4	4
Size, inches	4	6	- - -	- - -	- - -	None	1½	1½	1½	1½
Machine dimensions (L x W x H), feet	16.8x14.8 x 13.7	20x15.11 x 14	7 x 7	- - -	- - -	11x4x4	9 x 6 x 6	9 x 6 x 6	9 x 6 x 6	9 x 6 x 6
Approx. floor space required, sq. ft.	300	400	- - -	- - -	- - -	44	11x8x8	11x8x8	11x8x8	11x8x8
Approx. shipping weight, lbs.	17,700	26,000	- - -	- - -	- - -	2,900	3,250*	3,250*	3,250*	3,250*
Special features	Can be equipped with accumulator heads. Provide for continuous extrusion. →		Oil hydraulic clamping. →		Resin Reservoir. →	Special laminates can be blow-formed.	Twin station, 2-head.	Twin station, 6-head.	Twin station, 8-head.	Single station, 2-head.
	(See above for this machine also.)		No post-finishing. →				Individual stations, each can work with different mold sizes. V-type has less pressure loss. →			
Optional features avail. at extra cost	(See above) →		Needle for blowing.	- - -	- - -	- - -	Overload warning device. →			
Approximate delivery time, weeks	12 - 16	16	6 - 8	6 - 8	10 - 14	8 - 10	6	6	6	6

Note: Blank spaces denote material not submitted by manufacturer.

* From sheet plastic.
** at 50 psi. pressure

* Without extruder.

	Moslo	Prodex				Quality	Rainville #		
Manufacturer*									
Machine Model	1246	96	149	2424	4848	NBM #100	Rainblow	Rotary, 4- & 6-Station	Blow-O-Matic
Type of preliminary operation, etc.	Injection	Extruder	Extruder	Extruder	Extruder	Extrusion	Extrusion	Extrusion	Extrusion
Method of operation	Automatic	Automatic				Automatic	Manual, auto.	Automatic	Manual, auto.
Number of molds	1 - 6	1 - 4	1 - 4	1 - 2	1 - 2	2	Double platen	4,6,12,18	Single platen
Number of pieces per cycle	1 - 6	1 - 8	1 - 8	1 - 2	1 - 2	2 min.	2 - 4	3/station	1 - 5 or more
Hopper capacity, lbs.	75	50	100	100	100	100	50	100	50
Platen area, W x D, inches	10.8x14x5	9½ x 6½	14 x 9½	24 x 24	48 x 48	10 x 18	12 x 20	8 x 8	20 x 20 max.
Clamp tonnage or Mold closing force, tons	90	3	4½	10	36	1-3/4	5	Min. 1½ on 6-stations	7 maximum
Daylight opening, inches	6	5½	5-5/8	18	30	23	25	9-3/4	30 maximum
Platen stroke, inches	6	5½	10-1/8	41	60	10	11	7	80
Max. size of part moldable:									
Diameter, inches or W x D	5-3/4	9	17	18	30	9-3/4	10½	1 qt. containers on 6-station	10
Length, inches	10	5	7	24	48	50	No limit	2 gal. containers on 4-station	26
Projected cross-section area, sq. in.	27	Depends on mold design.				145 @ 30 psi.	330	"	400
Dry cycle time (without cooling), minutes	0.10	0.033-0.066	0.42-0.083	0.167	0.167	0.020	0.066	0.055 on 6-station; 0.011 on 4-station	0.055-0.2
Output, lbs./hr., of finished parts, etc.	625	30 - 80	60 - 160	75 - 200	75 - 200	100	350	390	350 max.
Recommended preliminary machine size, etc.	4-6 oz.	1-3/4,20:1	2½,20:1	2½,20:1	2½,20:1	2½,20:1	4½ max.; 20:1	4½ max.; 20:1	4½ max.; 20:1
Tie bars: Number	None	None	None	2	4	2	None	None	3
Size, inches	- - -	- - -	- - -	2½	2½	1½	- - -	- - -	2½
Machine dimensions (L x W x H), feet	8.5x4.5x 7.7	7x2x4*	10x2x4*	13x3x5*	16x5x6*	8½x7½x6	3x15, w/o extruder	7' dia. w/o extruder	4x8x6 w/o extruder
Approx. floor space required, sq. ft.	80	7 x 2*	10 x 2*	13 x 3*	16 x 5*	44	45	- - -	32 w/o extruder
Approx. shipping weight, lbs.	9,000	2,000	3,500	8,000	12,000	1,800	2,000	3,000	3,000 w/o extruder
Special features	Requires no secondary operations (trimming or reming)	Single extruder head with reciprocating mult. cavities. Pincer type. Toggle clamp.		Accumulator.		Fast set-ups, plug-in timers & relays; each station can run independently, separate controls for extr. lengths.	Manifold return head. Molding area is clear because no tie bars.	Hi-speed bottle & container production.	Patented continuous prod. & finished I.D. & O.D. molded necks on bottles.
Optional features, avail. at extra cost	Precompression inj. system. Injram speed control. Extra tooling.	Special provision for rigid PVC.				Safety doors.	Manifold extrusion heads.	Special units to meet specs.	Manifold adjustable extrusion heads.
Approx. delivery time, weeks	4	8	10	12	14	3 - 4	4	12	In stock

* Excluding extruder.

	Royle			Stokes		Williams, White	Waldron-Hartig
Manufacturer*							
Machine model	5 T	10 T	20 T	855	856	# 3000	2424D-10
Type of preliminary operation, etc.	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion
Method of operation	Auto.	Auto.	Auto.	Auto., Semi-auto. & manual.		Automatic	Automatic
Number of molds	2	2, 4	2, 4	2, 4	2, 4	2	2 - 4
Number of pieces per cycle	2	2, 4	2, 4	2, 4	2, 4	2	2 - 4
Hopper capacity, lbs.	4*	6*	8*	50	50	1,500	200 - 400
Platen area, W x D, inches	15 x 15	20 x 20	31 x 31	18 x 8	17½ x 14	50 x 50	24 x 24
Clamp tonnage or mold closing force, tons	5	10	20	1½	5	80	10
Daylight opening, inches	14	18	36	18	28	50	34 max.
Platen stroke, inches	7	9	18	8	13	24	14
Max. size of part moldable:							
Diameter, inches or W x D	6	8	16	7.75	12.75	Will mold a 55-gal. drum	16
Length, inches	30	30	30	36¼	36¼	50	36¼
Projected cross-section area, sq. in.	150	300	600	60 - 70*	200 - 250*	1,200	200
Dry cycle time (without cooling), minutes	0.021	0.032	0.075	0.084	0.090	6	0.05
Output, lbs./hr., of finished parts, etc.	80	125	500	Depends on capacity of extruder.		2,000	450
Recommended preliminary machine size, etc.	2",20:1	2½",20:1	4½",20:1	2½",20:1	2½" or 3½", 20:1	10", 20:1	4½",20:1
Tie bars: Number	2	2	2	2	2	4	4
Size, inches	2	2½	3	1.50	- - -	4	3
Machine dimensions (L x W x H), feet	- - -	- - -	- - -	9x8.5x12	9x12x12	31x22x12	9-2/3x4x6½
Approx. floor space required, sq. ft.	100	125	175	40	- - -	1,200	4 x 10
Approx. shipping weight, lbs.	9,000	10,500	15,000	5,000	7,000	52,000	18,000-20,000*
Special features	Adjustable pressure valving in manifold heads.			Open construction. Easy access for set-up and maintenance.		Can blow-mold a 50-lb. shot of mat'l. Has 100-ton accumulator.	All hydr. operation, cooling water manifold.
Optional features avail. at extra cost				Elec. safety interlocks; flanged manifold.		Parison follower.	Special heads, accumulators.
Approx. delivery time, weeks	- - -	- - -	- - -	4-6 max.	4-6 max.	24	10

* Cubic feet.

* At 20 psi. air pressure.

* Depending on size of extruder.

PT's Classified List of Auxiliary Equipment for Extrusion and Blow Molding

Controllers & Regulators, Extrudate Thickness

Curtiss-Wright Corp., Electronics Div., Industrial Controls Dept., 35 Market St., E. Paterson, N. J.
The Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
GPE Controls Inc., 240 E. Ontario St., Chicago 11, Ill.
Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus 26, O.
Minneapolis-Honeywell Regulator Co., 2747 Fourth Ave. S., Minneapolis 8, Minn.
Photobell Co., Inc., 43 Vesey St., New York 7, N. Y.
Photomation, Inc., 96 S. Washington Ave., Bergenfield, N. J.
Tracerlab, Inc., 1601 Trapelo Blvd., Waltham 54, Mass.
Weston Instruments, Div. of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J.

Controllers & Regulators, Machine Cycle

Eagle Signal Corp., 202-20th St., Moline, Ill.
Electronic Processes Corp. of Calif., 436 Bryant, San Francisco 7, Calif.
Foster & Allen, Inc., 26 Commerce St., Chatham, N. J.
The Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
GPE Controls Inc., 240 E. Ontario St., Chicago 11, Ill.
General Electric Co., Apparatus Sales Div., 1 River Rd., Schenectady 5, N. Y.
Glenn Electric Heater Corp., 372 Jeliff Ave., Newark 8, N. J.
Partlow Corp., 225 Campion Rd., New Hartford, N. Y.
Plastics by Chapman, 1220 S. 49th St., Richmond, Calif.
Reliance Electric & Engineering Co., 24701 Euclid Ave., Cleveland 17, O.
Seely Instrument Co., Inc., 377 Fourth St., Niagara Falls, N. Y.
Taylor-Emmett Controls, Inc., 445 E. Turkeyfoot Lake Rd., Akron 19, O.
Taylor Instrument Companies, 95 Ames St., Rochester 1, N. Y.
Wallace & Tiernan, Inc., 25 Main St., Belleville 9, N. J.
G. C. Wilson & Co., 1915 Eighth Ave., Huntington W. Va.

Controllers & Regulators, Pressure

Fischer & Porter Co., 30 Warminster Rd., Hatboro, Pa.
The Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
GPE Controls Inc., 240 E. Ontario St., Chicago 11, Ill.
Gabriel Mfg. Co., 15 Maple Ave., Haverstraw, N. Y.
General Electric Co., Apparatus Sales Div., 1 River Rd., Schenectady 5, N. Y.
Helicoid Gage Div., American Chain & Cable, 929 Connecticut Ave., Bridgeport 2, Conn.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia 44, Pa.
Leslie Co., 214 Leslie Bldg., Lyndhurst, N. J.
Minneapolis-Honeywell Regulator Co., 2747 Fourth Ave. S., Minneapolis 8. Minn.
Powers Regulator Co., 3400 Oakton St., Skokie 34, Ill.
Taylor Instrument Companies, 95 Ames St., Rochester 1, N. Y.
United Electric Controls Co., 85 School St., Watertown 72, Mass.
Weston Instruments, Div. of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J.

Controllers & Regulators, Take-Away

Foster & Allen, Inc., 26 Commerce St., Chatham, N. J.
The Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Photomation, Inc., 96 S. Washington Ave., Bergenfield, N. J.
Sterling, Inc., 5200 W. Clinton Ave., Milwaukee 18, Wis.
Weston Instruments, Div. of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J.

Controllers & Regulators, Temperature

Application Engineering Corp., P.O.Box 334, Park Ridge, Ill.
Barber-Colman Co., Wheelco Instruments Div., 1300 Rock St., Rockford, Ill.
Electric Auto-Lite Co., General Products Group, Champlain, Toledo 1, O.
Electronic Processes Corp. of Calif., 436 Bryant, San Francisco 7, Calif.
Fenwal, Inc., 32 Pleasant Street, Ashland, Mass.
Fischer & Porter Co., 30 Warminster Rd., Hatboro, Pa.
The Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Electric Co.., Apparatus Sales Div., 1 River Rd., Schenectady 5, N. Y.
Glenn Electric Heater Corp., 372 Jelliff Ave., Newark 8, N. J.
Industrial Mfg. Corp., 31 E. Georgia St., Indianapolis 4, Ind.
Jones Motrola Corp., 432 Fairfield Ave., Stamford, Conn.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia 44, Pa.
Leslie Co., 214 Leslie Bldg., Lyndhurst, N. J.
Mayer Refrigerating Engineers, Boonton Turnpike, Lincoln Park, N. J.
Minneapolis-Honeywell Regulator Co., 2747 Fourth Ave. S., Minneapolis 8, Minn.
The Partlow Corp., 225 Campion Rd., New Hartford, N. Y.
Powers Regulator Co., 3400 Oakton St., Skokie 34, Ill.
Pyrometer Instrument Co., Inc., 92 Portland St., Bergenfield, N. J.
Reliance Electric & Engineering Co., 24701 Euclid Ave., Cleveland 17, O.
Sarco Co., Inc., 635 Madison Avenue, New York 22, N. Y.
Sterling, Inc., 5200 W. Clinton Avenue, Milwaukee 18, Wis.
Taylor Instrument Companies, 95 Ames Street, Rochester 1, N. Y.
Thermo Electric Co., Inc., 109 Fifth Street, Saddle Brook, N. J.
Thwing-Albert Instrument Co., 5398 Pulaski Avenue, Philadelphia 44, Pa.
United Electric Controls Co., 85 School St., Watertown 72, Mass.
West Instrument Corp., 4263 W. Montrose Ave., Chicago 41, Ill.
Weston Instruments, Div. of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J.

Conveyors

Abbott Plastic Machine Corp., 7124 N. Clark Street, Chicago 26, Ill.
E. B. Blue Co., 651 Connecticut Avenue, S. Norwalk, Conn.
Brady Conveyors Corp., 4244 Dempster Street, Skokie, Ill.
Carpco Mfg., Inc., 4120 Haines Street, Jacksonville 6, Fla.
Chain Belt Co., 4701 W. Greenfield Avenue, Milwaukee 1, Wis.
D. C. Cooper Co., 1467 S. Michigan Ave., Chicago 5, Ill.
The J. H. Day Co., Div. of Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, O.
Dean Panel Coil Div., Dean Products, Inc., 1048 Dean Street, Brooklyn 38, N. Y.
Dracco Div. of Fuller Co., 4063 E. 116th Street, Cleveland 5, O.
Frank W. Egan & Co., 671 S. Adamsville Road, Somerville, N. J.
Vern Emery Co., 10647 Wixom Street, Sun Valley, Calif.
The Falls Engineering & Machine Co., 1734 Front Street, Cuyahoga Falls, O.
Ferry Machine Co., W. Main Street Extension, Kent, O.
Herbert Products, Inc., 74-32 Jamaica Ave., Woodhaven 11, N. Y.
Indiana Commercial Filter Corp., Lebanon, Ind.
Island Equipment Corp., 1090 E. 31st Street, Hialeah, Fla.
Jennings Engineering Co., 3444 Ludlow St., Philadelphia 4, Pa.
Karlton Machinery Corp., 210 E. Ohio St., Chicago 11, Ill. (Rep. for Becker & Van Hullen)
L & P Tool Co., 2861 Sidney Avenue, Cincinnati 25, O.
Leon Machine & Engineering Co., 61 Whittaker St., Riverside, N. J.
Magnetic Engineering & Mfg. Co., 851 Van Houten Ave., Clifton, N. J.
Mercury Heat Sealing Equipment Co., 2601-21 N. Howard Street, Philadelphia 33, Pa.
Mitchell Specialty Div., Industrial Enterprises, Inc., Edmund & Whelmire Sts., Phila., 36, Pa.
Modern Plastic Machinery Corp., 64 Lakeview Avenue, Clifton, N. J.
Motch & Merryweather Machinery Co., 1258 E. 222nd Street, Cleveland 17, O.
National Rubber Machinery Co., 47 W. Exchange Street, Akron 8, O.
The Oliver Corp., A. B. Farquhar Div., 142 N. Duke Street, York, Pa.
Omni Products Corp., 460 Park Ave. S., New York 16, N. Y.
Plastic Fabricants, Div. of The Woodman Co., Inc., 647 E. College Ave., Decatur, Ga.
Prodex Corp., King George Road, Fords, N. J.
Pulverizing Machinery Div., Metals Disintegrating Co., Inc., 30 Chatham Rd., Summit, N. J.
Read Standard, Div. of Capitol Products Corp., 901 S. Richland Ave., York, Pa.
Robinson Air-Activated Conveyor Systems, 80 Fifth Avenue, New York 11, N. Y.
Spencer Turbine Co., 486 New Park Avenue, Hartford 6, Conn.
Sprout, Waldron & Co., Inc., 130 Logan Street, Muncy, Pa.
Standard Conveyor Co., 315 N. W. 2nd Street, St. Paul 9, Minn.
Sterling Extruder Corp., 1112 Baltimore Ave., Linden, N. J.
Syntron Co., P.O.Box 2200, Homer City, Pa.
Tote System, Inc., 710 S. Seventh, Beatrice, Nebr.
Union Tool Corp., 900 N. Detroit St., Warsaw, Ind.
John Verduin Machine Corp., 345-357 Tenth Avenue, Paterson 4, N. J.
Waldron-Hartig Div., Midland-Ross Corp., P.O. Box 531, Westfield, N. J.
L. R. Wallace & Co., Box 271, Glenside, Pa.
Werner & Pfleiderer Corp., 500 Fifth Avenue, New York 36, N. Y.
Whitlock Associates, Inc., 21655 Coolidge Highway, Oak Park 37, Mich.
Wilkinson Co., 619 E. Tallmadge Avenue, Akron 10, O.
Young Machinery Co., Inc. R.D #2, Muncy, Pa.

Cooling Devices

Adamson United Co., 730 Carroll St., Akron 4, O.
A1-Be Industries, 9516 Rayo Street, South Gate, Calif.
Anson Tools & Gages, Inc., 1504 W. 12th Street, Erie, Pa.
Artisan Metal Products, Inc., 63 Pond Street, Waltham 54, Mass.
Barclay Industries, Inc., 420 Lexington Avenue, New York 17, N. Y. (Rep. for Peuchin, Inc.)
Black-Clawson Co., Dilts Div., 46 N. First Street, Fulton, N. Y.
Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pa.
Continental Machinery Co., 261 Broadway, New York 7, N. Y.
Dean Panel Coil Div., Dean Products, Inc., 1048 Dean Street, Brooklyn 38, N. Y.
Frank W. Egan & Co., 671 S. Adamsville Road, Somerville, N. J.
Electric Trading Co., 313-315 Canal Street, New York 13, N. Y.
Entwistle Mfg. Corp., 1475 Elmwood Avenue, Providence 7, R. I.
Faeco Machine Co., Inc., 643 21st Avenue, Box 6, Paterson, N. J.
Gerin Mfg. Co., Inc., 683-685 N. 5th Street, Newark 7, N. J.
Goulding Mfg. Co., 2929 River Stteet, Sagi-

naw, Mich.
Industrial Ovens Inc., 13825 Triskett Road, Cleveland 11, O.
Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, O.
JMC Co., 90 Elizabeth Avenue, Elizabeth, N. J.
L & P Tool Co., 2861 Sidney Avenue, Cincinnati 25, O.
Lembo Machine Works, Inc., 248 E. 17th Street, Paterson 4, N. J.
Liberty Machine Co., Inc., 275 Fourth Avenue, Paterson 4, N. J.
Mayer Refrigerating Engineers, Boonton Turnpike, Lincoln Park, N. J.
Mercury Industries, Inc., 365 Broadway, Hillside, N. J.
Mercury Molding Machinery, Inc., 972 Nepperhan Avenue, Yonkers, N. Y.
Modern Plastic Machinery Corp., 64 Lakeview Avenue, Clifton, N. J.
Motch & Merryweather Machinery Co., 1258 E. 222nd Street, Cleveland 17, O.
National Rubber Machinery Co., Plastics Machinery Div., 47 W. Exchange St., Akron 8, O.
Omni Products Corp., 460 Park Ave. S., New York 16, N. Y.
Pecorp, Inc., Basin Rd., P.O. Box 3164, Wilmington 4, Del.
The Rainville Co., Inc., 839 Stewart Avenue, Garden City, N. Y.
Reliable Rubber & Plastic Machinery Co., Inc., 2014 Union Turnpike, No. Bergen, N. J.
Saren, Inc., 618 N. Kostner Ave., Chicago 51, Ill.
T. Shriver & Co., Inc., 808 Hamilton Street, Harrison, N. J.
Sterling Extruder Corp., 1112 Baltimore Avenue, Linden, N. J.
Sterling, Inc., 5200 W. Clinton Avenue, Milwaukee 18, Wis.
Tenney Engineering, Inc., 1090 Springfield Rd. Union, N. J.
John Verduin Machine Corp., 345-357 Tenth Avenue, Paterson 4, N. J.
Vic Mfg. Co., 1313 Hawthorne Ave., Minneapolis, Minn.
Waldron-Hartig Div., Midland-Ross Corp., P.O. Box 531, Westfield, N. J.
Werner & Pfleiderer Corp., 500 Fifth Avenue, New York 36, N. Y.
Wilkinson Co., 619 E. Tallmadge Avenue, Akron 10, O.

Cutters

Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pa.
Clifton Hydraulic Press Co., 289 Allwood Rd., Clifton, N. J.
Continental Machinery Co., Inc., 261 Broadway, New York 7, N. Y.
Custom Machine & Design, Inc., P.O. Box 1064, 200 S. Forge Street, Akron 9, O.
Eastman Machine Co., 779 Washington Street, Buffalo 3, N. Y.
Emerson Mfg. Co., 9 Osgood Street, Lawrence, Mass.
Vern Emery Co., 10647 Wixom Street, Sun Valley, Calif.
Faeco Machine Co., Inc., 643-21st Avenue, Box 6, Paterson, N. J.
Falls Engineering & Machine Co., 1734 Front Street, Cuyahoga Falls, O.
Famco Machine Co., 3100 Sheridan Road, Kenosha, Wis.
Foster & Allen, Inc., 26 Commerce Street, Chatham, N. J.
G & S Label Corp., 49 West 27th Street, New York 1, N. Y.
Game Bros. & Lane, Inc., 1335 W. Lake Street, Chicago 7, Ill.
Heinrich Equipment Corp. (US Rep. for Reifenhauser Plastics Machinery Corp.), 111 Eighth Avenue, New York 11, N. Y.
Hobbs Mfg. Co., 26 Salisbury Street, Worcester 5, Mass.
Johnson Machinery Co., Inc., 90 Elizabeth Avenue, Elizabeth, N. J.
Karlton Machinery Corp., 210 E. Ohio Street, Chicago 11, Ill. (Rep. for Becker & Van Hullen)
The Lawson Co., Div. of Miehle-Goss-Dexter, Inc., 2011 Hastings Street, Chicago 8, Ill.
Liberty Machine Co., Inc., 275 Fourth Avenue, Paterson 4, N. J.
Lupoline Automatic Polishing Equipment Corp., 4510 Bullard Ave., Bronx 70, N. Y.
H. Maimin Co., Inc., 575 Eighth Avenue, New York 18, N. Y.
Franklin P. Miller & Son, 36 Meadow Street, E. Orange 16, N. J.
Omni Products Corp., 460 Park Ave. S., New York 16, N. Y.
Progressive Machine Co., Inc., 167-169 E. 31st Street, Paterson 4, N. J.
Reliable Rubber & Plastic Machinery Co., Inc., 2014 Union Turnpike, No. Bergen, N. J.
Robbins Plastic Machinery Corp., 1430 Mishawaka Street, Elkhart, Ind.
Ruf Machine Co., Inc., 416 E. 93rd Street, New York 28, N. Y.
Sherman Rubber Co., Div. of Botwinik Bros. of Mass., Inc., 2 Sherman St., Worcester 1, Mass.
Spadone Machine Co., Inc., Connecticut Avenue, S. Norwalk, Conn.
United Shoe Machinery Corp., 140 Federal Street, Boston 7, Mass.
Utility Mfg. Co., 4758 S. Kingan Avenue, Cudahy, Wis.
Waldron-Hartig Div., Midland-Ross Corp., P.O. Box 531, Westfield, N. J.
Werner & Pfleiderer Corp., 500 Fifth Avenue, New York 36, N. Y.
Wysong & Miles Co., 625 Fulton Street Greensboro, N. C.

Cylinders, Extruder

Aetna-Standard Div., Blaw-Knox Co., c/o Hale & Kullgren, Inc., P.O. Box 1231, Akron 9, O.
Industrial Research Laboratories, Div. of Honolulu Oil Corp., 961 E. Slauson Ave., Los Angeles 11, Calif.
JMC Company, 90 Elizabeth Avenue, Elizabeth, N. J.
Omni Products Corp., 460 Park Ave. S., New York 16, N. Y.
John Royle & Sons, 10 Essex Street, Paterson 3, N. J.
Sawaga Manufacturing Co., Inc., 305 State Street, Trinidad, Colo.

Dicers & Choppers

Abbe Engineering Co., 420 Lexington Avenue, New York 17, N. Y.
Acme Machinery & Mfg. Co., Inc., 500 Saw Mill River Road, Yonkers, N. Y.
Aetna-Standard Div., Blaw-Knox Co., c/o Hale & Kullgren, Inc., P.O. Box 1231, Akron 9, O.
Alsteele Engineering Works, Inc., 82 Herbert Street, Framingham, Mass.
American Pulverizer Co., 1249 Macklind Ave., St. Louis 10, Mo.
Atlas-Sandt Corp., 240-42 W. 23 Street, New York 11, N. Y.
Ball & Jewell, Inc., 24-28 Franklin Street, Brooklyn 22, N. Y.
Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pa.
Brosites Machine Co., Inc., 50 Church Street, New York 7, N. Y.
Carbert Mfg. Co., Inc., 143 Sidney Street, Cambridge 39, Mass.
Arthur Colton Co., Div. of Snyder Corp., 3400 E. Lafayette St., Detroit 7, Mich.
Continental Machinery Co., Inc., 261 Broadway, New York 7, N. Y.
Cumberland Engineering Co., Inc., P.O. Box 216, Providence, R. I.
Custom Machine & Design, Inc., P. O. Box 1064, 200 S. Forge Street, Akron 9, O.
DeMattia Machine & Tool Co., Brighton & Chelsea Rd., Clifton, N. J.
Ferry Machine Co., W. Main Street Extension, Kent, O.
Foster & Allen, Inc., 26 Commerce Street, Chatham, N. J.
Hale & Kullgren, Inc., 613 E. Tallmadge Ave., Box 1231, Akron, O.
Hobbs Mfg. Co., 26 Salisbury Street, Worcester 5, Mass.
Johnson Machinery Co., 90 Elizabeth Avenue, Elizabeth 5, N. J.
Mitts & Merrill, 1016 S. Water Street, Saginaw, Mich.
Franklin P. Miller & Son, 36 Meadow Street, E. Orange 16, N. J.
Modern Plastic Machinery Corp., 64 Lakeview Ave., Clifton, N. J.
Motch & Merryweather Machinery Co., 1258 E. 222nd Street, Cleveland 17, O.
Omni Products Corp., 460 Park Ave. S., New York 16, N. Y.
Radial Cutter Mfg. Corp., 831 Bond St., Elizabeth 4, N. J.
The Rainville Co., Inc., 839 Stewart Ave., Garden City, N. Y.
Spadone Machine Co., Inc., Connecticut Avenue, S. Norwalk, Conn.
Sprout, Waldron & Co., Inc., 130 Logan Street, Muncy, Pa.
Taylor Stiles & Co., 13 Bridge Street, Riegelsville, N. J.
Thoreson-McCosh, Inc., 18208 McNichols Rd., Detroit 19, Mich.
The Van Dorn Iron Works Co., 2685 East 79th Street, Cleveland, O.

Dies, Extrusion

ABA Tool & Die Co., Inc., 1395 Tolland Turnpike, Manchester, Conn.
Ace Plastic Molding Corp., 5-01-47th Rd., Long Island City 1, N. Y.
Ace Tool & Mfg Co., 532 Mulberry Street, Newark 5, N. J.
Aetna-Standard Div., Blaw-Knox Co., c/o Hale & Kullgren, Inc., P.O. Box 1231, Akron 9, O.
A1-Be Industries, 9516 Rayo Street, South Gate, Calif.
Anson Tools & Gages, Inc., 1504 W. 12th Street, Erie, Pa.
Astor Tool & Die Co., 5-01-47th Road, Long Island City 1, N. Y.
Auburn Plastics, Inc., 24 McMaster Street, Auburn, N. Y.
Barclay Industries, Inc., 420 Lexington Avenue, New York, N. Y.
Beazy's Moldmakers, 323 W. Fifth, Box 338, Peru, Ind.
Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pa.
Chandler Equipment Engineering Co., 1755 S. Zeyn Street, Anaheim, Calif.
Frank W. Egan & Co., 671 S. Adamsville Rd., Somerville, N. J.
Electro Plastics Corp., 1201 Levee Street, Dallas 7, Texas
Essex Plastic Machinery Co., 53 Rantoul Street, Beverly, Mass.
Faeco Machine Co., Inc., 643-21st Avenue, Box 6, Paterson, N. J.
Federal Tool Corp., 3600 W. Pratt Blvd., Chicago 45, Ill.
General American Transportation Corp., Plastics Div., 135 S. LaSalle St., Chicago 90, Ill.
Haveg Industries, Inc., Technical Dept., 900 Greenbank Rd., Wilmington 8, Del.
Heinrich Equipment Corp., 111 Eighth Ave., New York 11, N. Y.
Industrial Engineering Service, Washington Street, S. Easton, Mass.
Johnson Mfg. Co., Inc., Highway 178, Chippewa Falls, Wis.
Killion Tool & Mfg. Co., 56 Depot, Verona, N. J.
E. B. Kingman Co., 96 Exchange Street, Leominster, Mass.
John Kunst Co., 41 Murray Street, New York 7, N. Y.
L & P Tool Co., 2861 Sidney Avenue, Cincinnati 25, O.
Libbert Plastics, Inc., 5331 White Settlement Rd., P.O. Box 9066, Fort Worth 14, Tex.
J. Many & Co., 153 Lafayette Street, New York 13, N. Y.
Modern Plastic Machinery Corp., 64 Lakeview Avenue, Clifton, N. J.
National Rubber Machinery Co., Plastics Machinery Div., 47 W. Exchange St., Akron 8, O.
New England Die Co., Inc., 64 Floral Street, Taunton, Mass.
Oakley Die & Mfg. Co., Inc., 4426 Brazee St., Cincinnati 9, O.
Payne Tool & Engineering Co., 1300 W. Columbia St., Springfield, O.
Plastic Extruded Products Co., 309 Port Ave., Elizabeth 1, N. J.
Plastic Mold Tool & Die Co., Inc., 1 Maple Street, E. Rutherford, N. J.
Pyramid Screen Corp., 181 Harvard St., Brookline 46, Mass.
Robbins Plastic Machinery Corp., 1430 Mishawaka St., Elkhart, Ind.
Roehlen Engraving Works, 324 St. Paul St., Rochester 5, N. Y.
John Royle & Son, 10 Essex St., Paterson 3, N. J.
Skyline Industries, Inc., Titusville, Pa.
Sterling Extruder Corp., 1112 Baltimore Ave., Linden, N. J.
Stricker-Brunhuber Corp., 19 W. 24th Street, New York 10, N. Y.
Superior Plastics, Inc., 410-430 N. Oakley Blvd., Chicago 12, Ill.
Sussex Plastic Co., 85 Academy Street, Belleville 9, N. J.
Thermoplastic Equipment Corp., Div. of

Thermoplastic Processes, Inc., Valley Rd., Stirling, N. J.
Thermoplastic Processes, Inc., Valley Road, Stirling, N. J.
Victory Plastics Co., 81 Apsley Street, Hudson, Mass.
Waldron-Hartig Div., Midland-Ross Corp., P.O. Box 531, Westfield, N. J.
Western Supplies Co., 2920 Cass Avenue, St. Louis 6, Mo.
Yates Co., 2211 Peninsula Dr., Erie, Pa.

Handling Equipment for Extruded Items

Aetna-Standard Div., Blaw-Knox Co., c/o Hale & Kullgren, Inc., P.O. Box 1231, Akron 9, O.
A1-Be Industries, 9516 Rayo Street, South Gate, Calif.
Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pa.
Frank W. Egan & Co., 671 S. Adamsville Rd., Somerville, N. J.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Ferry Machine Co., West Main Street Extension, Kent, Ohio
Fife Mfg. Co., P.O. Box 9815, Oklahoma City 18, Okla.
Goulding Mfg Co., 2929 River Street, Saginaw, Mich.
Heinrich Equipment Corp., (US Rep. for Reifenhauser Plastics Machinery Corp.),111 Eighth Ave., New York, 11, N. Y.
Heppenstall Co., 4620 Hatfield Street, Pittsburgh 1, Pa.
Hobbs Mfg. Co., 26 Salisbury Street, Worcester 5, Mass.
JMC Co., 90 Elizabeth Ave., Elizabeth, N. J.
Johnson Mfg. Co., Inc., Highway 178, Chippewa Falls, Wis.
Lewis-Shepard Products, Inc., 125 Walnut Street, Watertown 72, Mass.
Modern Plastic Machinery Corp., 64 Lakeview Avenue, Clifton, N. J.
Mount Hope Machinery Co., 15 Fifth Street, Taunton, Mass.
Omni Products Corp., 460 Park Ave. S., New York 16, N. Y.
Prodex Corp., King George Road, Fords, N. J.
Progressive Machine Co., Inc., 167-169 E. 31st Street, Paterson 4, N. J.
The Rainville Co., Inc., 839 Stewart Avenue, Garden City, N. Y.
Robbins Plastic Machinery Corp., 1430 Mishawaka Street, Elkhart, Ind.
Sterling Extruder Corp., 1112 Baltimore Ave., Linden, N. J.
Waldron-Hartig Div., Midland-Ross Corp., P.O. Box 531, Westfield, N. J.

Heaters

Atlas Machine & Tool Corp., 259 Hackensack St., East Rutherford, N. J.
Chromalox, Inc., 7506 Thomas Blvd., Pittsburgh 8, Pa.
General Electric Co., Apparatus Sales Div., 1 River Rd., Schenectady 5, N. Y.
Hotwatt, Inc., 75 Maple St., Danvers, Mass.
Industrial Heater Co., Inc., 417 Canal Street, New York 13, N. Y.
Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, O.
New Jersey Thermex Co., Inc., 531 Bergen Street, Harrison, N. J.
Thermel, Inc., 9400 Robinson Rd., Franklin Park, Ill.
Vulcan Electric Co., 88 Holten Street, Danvers 32, Mass.
Watlow Electric Mfg. Co., 1376 Ferguson Ave., St. Louis 14, Mo.

Hopper Loaders

Goulding Mfg. Co., 2929 River Street, Saginaw, Mich.
Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, O.
Ketchpel Engineering Co., 1401-04 Palisade Ave., W. Englewood, N. J.
Omni Products Corp., 460 Park Ave. S., New York 16, N. Y.
Rainco Mfg. Inc., R. D. #2, Franklin, Pa.
The Rainville Co., 839 Stewart Avenue, Garden City, N. Y.
Robbins Plastic Machinery Corp., 1430 Mishawaka St., Elkhart, Ind.
Spencer Turbine Co., 486 New Park Ave., Hartford 6, Conn.
Thoreson-McCosh, Inc., 18208 McNichols Rd., Detroit 19, Mich.
Whitlock Associates, Inc., 21655 Coolidge Highway, Oak Park 37, Mich.

Indicators, Machine Cycle

Foster & Allen, Inc., 26 Commerce St., Chatham, N. J.
The Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus 26, O.
Minneapolis-Honeywell Regulator Co., 2747 Fourth Avenue S., Minneapolis 8, Minn.
Pratt & Whitney Co., Inc., Charter Oak Blvd., W. Hartford 1, Conn.
Seely Instrument Co., Inc., 377 Fourth St., Niagara Falls, N. Y.
Taylor Instrument Companies, 95 Ames St., Rochester 1, N. Y.

Indicators, Pressure

Fischer & Porter Co., 30 Warminster Rd., Hatboro, Pa.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., 2747 Fourth Avenue S., Minneapolis 8, Minn.
Taber Instrument Corp., 107 Goundry Street, N. Tonawanda, N. Y.
Taylor Instrument Companies, 95 Ames Street, Rochester 1, N. Y.
Testing Machines, Inc., 72 Jericho Turnpike, Mineola, N. Y.
United Electric Controls Co., 85 School Street, Watertown 72, Mass.
United Sensor & Control Corp., 122 Naubuc Ave., Glastonbury, Conn.
Wallace & Tiernan, Inc., 25 Main Street, Belleville 9, N. J.
Weston Instruments, Div. of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J.

Indicators, Temperature

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Barber-Colman Co., Wheelco Instruments Div., 1300 Rock Street, Rockford, Ill.
Electric Auto-Lite Co., General Products Group, Champlain, Toledo 1, O.
Electronic Processes Corp. of Calif., 436 Bryant, San Francisco 7, Calif.
Fisher Scientific Co., 711 Forbes Ave., Pittsburgh 19, Pa.
The Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Industrial Development Laboratories, Inc., 982 River Rd., Edgewater, N. J.
Jones Motrola Corp., 432 Fairfield Ave., Stamford, Conn.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., 2747 Fourth Avenue S., Minneapolis 8, Minn.
Partlow Corp., 225 Campion Rd., New Hartford, N. Y.
Powers Regulator Co., 3400 Oakton Street, Skokie 34, Ill.
Pyrometer Instrument Co., Inc., 92 Portland Street, Bergenfield, N. J.
Pyrometer Service Co., Inc., 348 River Road, N. Arlington, N. J.
Taylor Instrument Companies, 95 Ames Street, Rochester 1, N. Y.
Testing Machines, Inc., 72 Jericho Turnpike, Mineola, N. Y.
United Electric Controls Co., 85 School Street, Watertown 72, Mass.
United Sensor & Control Corp., 122 Naubuc Avenue, Glastonbury, Conn.
West Instrument Corp., 4263 W. Montrose Ave., Chicago 41, Ill.
Weston Instruments, Div. of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J.

Liners, Extruder Cylinder

Acme Machinery & Mfg. Co., Inc., 500 Saw Mill River Road, Yonkers, N. Y.
Aetna-Standard Div., Blaw-Knox Co., c/o Hale & Kullgren, Inc., P. O. Box 1231, Akron 9, O.
Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pa.
Davis-Standard Div., Franklin Research Corp., 12 Water Street, Mystic, Conn.
Frank W. Egan & Co., 671 S. Adamsville Rd., Somerville, N. J.
Hale & Kullgren, Inc., 613 E. Tallmadge Ave., Box 1231, Akron, O.
Industrial Research Laboratories, Div. of Honolulu Oil Corp., 961 E. Slauson Ave., Los Angeles 11, Calif.
JMC Co., 90 Elizabeth Avenue, Elizabeth, N. J.
Omni Products Corp., 460 Park Ave. S., New York 16, N. Y.

Marking Machines

Ackerman Gould Co, 10 Neil Court, P.O. Box 188, Oceanside, N. Y.
The Acromark Co., 5-13 Morrell Street, Elizabeth 4, N. J.
Apex Machine Co., 14-13-118 Street, College Point 56, N. Y.
Defiance Machine & Tool Co., 1920 S. Vandeventer Ave., St. Louis 10, Mo.
Gane Bros. & Lane, Inc., 1335 W. Lake Street, Chicago 7, Ill.
Halvorfold Kwikprint Co., 700 E. Union, Jacksonville, Fla.
Industrial Marking Equipment Co., Inc., 655 Berriman Street, Brooklyn 8, N. Y.
Kingsley Machines, 850 Cahuenga Blvd., Hollywood 38, Calif.
Marken Machine Co., 150 Congress Street, Keene 20, N. H.
James H. Matthews & Co., 3829 Forbes Ave., Pittsburgh 13, Pa.
Olsenmark Corp., 124-132 White Street, New York 13, N. Y.
Omni Products Corp., 460 Park Ave., S., New York 16, N. Y.
Peerless Roll Leaf Co., Inc., 4511 New York Ave., Union City, N. J.
Skyline Industries, Titusville, Pa.
Superior Roll Leaf Mfrs., Inc., 14 Porter Street, Hackensack, N. J.
Swan Machine Corp., 320 Fifth Ave., New York 1, N. Y.
Weber Hot Stamping Equipment Co., 3253 N. Kedzie Ave., Chicago 13, Ill.

Mixers, Blending & Coloring

Abbe Engineering Co., 420 Lexington Avenue, New York 17, N. Y.
Paul O. Abbe, Inc., 257 Center Avenue, Little Falls, N. J.
Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pa.
Arthur Colton Co., Div. of Snyder Corp., 3400 E. Lafayette St., Detroit 7, Mich.
D. C. Cooper Co., 1467 S. Michigan Avenue, Chicago 5, Ill.
Crown Machinery, Inc., 2721 S. San Pedro Street, Los Angeles 11, Calif.
Dake Corp., 641 Robbins Rd., Grand Haven, Mich.
The J. H. Day Co., Div. of Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, O.
J. P. Devine Mfg. Co., 49th St. & A. V. R. R., Pittsburgh 1, Pa.
Entoleter Div., Safety Industries, Inc., 1187 Dixwell Ave., New Haven, Conn.
Ferro Corp., Patterson Equipment Div., E. Liverpool, O.
Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, O.
Johnson Machinery Co., 90 Elizabeth Ave., Elizabeth, N. J.
Lupoline Automatic Polishing Equipment Corp., 4510 Bullard Ave., Bronx 70, N. Y.
Franklin P. Miller & Son, 36 Meadow Street, E. Orange 16, N. J.
Patterson Foundry and Machine Co., 1250 St. George Street, E. Liverpool, O.
The Patterson-Kelley Co., Inc., E. Stroudsburg, Pa.
Prodex Corp., King George Road, Fords, N. J.
The Rainville Co., Inc., 839 Stewart Avenue, Garden City, N. Y.
Read Standard, Div. of Capitol Products Corp. 901 S. Richland Ave., York, Pa.
Reed Plastics Corp., 116 Gold Street, Worcester 8, Mass.
Reliable Rubber & Plastics Machinery Co., Inc., 2014 Union Turnpike, No. Bergen, N. J.
Charles Ross & Son Co., 148 Classon Ave., Brooklyn 5, N. Y.
Sprout, Waldron & Co., Inc., 130 Logan Street, Muncy, Pa.
The Strong-Scott Mfg. Co., 451 Taft Street, N. E., Minneapolis 13, Minn.
Sturtevant Mill Co., 103 Clayton Street, Boston, Mass.
Werner & Pfleiderer Corp., 500 Fifth Ave., New York 36, N. Y.
Young Machinery Co., Inc., R.D. #2, Muncy, Pa.

Rewinding Equipment

A1-Be Industries, 9516 Rayo Street, South Gate, Calif.

Associated Equipment Corp., 209 Pacific National Bank Bldg., Belleview, Wash.
The Black-Clawson Co., Dilts Div., 46 N. First Street, Fulton, N. Y.
Cameron Machine Co., Franklin Rd., Dover, N. J.
John Dusenbery Co., Inc., 271 Grove Ave., Verona, N. J.
Vern Emery Co., 10647 Wixom Street, Sun Valley, Calif.
Entwistle Mfg. Corp., 1475 Elmwood Ave., Providence 7, R. I.
Faeco Machine Co., Inc., 643-21st Ave., Box 6, Paterson, N. J.
Farris Universal Machine Corp., 400 Commercial Ave., Palisade Park, N. J.
G & S Label Corp., 49 West 27th Street, New York 1, N. Y.
Goulding Mfg. Co., 2929 River Street, Saginaw, Mich.
Hobbs Mfg. Co., 26 Salisbury Street, Worcester 5, Mass.
Industrial Ovens Inc., 13825 Triskett Rd., Cleveland 11, O.
Inta Roto Machine Co., Inc., P.O. Box 454, Richmond 3, Va.
Johnstone Engineering & Machine Co., First Ave. & Gay Street, Atglen, Pa.
Lee Machinery Corp., 28 W. 23rd St., New York 10, N. Y.
Lembo Machine Works, Inc., 248 E. 17th Street, Paterson 4, N. J.
Liberty Machine Co., Inc., 275 Fourth Avenue, Paterson 4, N. J.
C. A. Litzler Co., Inc., 235 Brookpark Road, Cleveland 9, O.
Monkley Corp., 42 Lagrange Street, Worcester 8, Mass.
Mount Hope Machinery Co., 15 Fifth Street, Taunton, Mass.
Omni Products Corp., 460 Park Ave. S., New York 16, N. Y.
Photobell Co., Inc., 43 Vesey Street, New York 7, N. Y.
Proctor & Schwartz, Inc., 7th Street & Tabor Rd., Philadelphia 20, Pa.
Progressive Machine Co., Inc., 167-169 E. 31st Street, Paterson 4, N. J.
Rotobond Co., P.O. Box 69, Bound Brook, N. J.
Ruf Machine Co., Inc., 416 E. 93rd Street, New York 28, N. Y.
Sealol Corp., Warwick Ind. Park, Providence 5, R. I.
The Alexander J. Shannon Co., 150 Broadway, New York 38, N. Y.
Stanford Engineering Co., Box 329, Salem, Ill.
John Verduin Machine Corp., 345-357 Tenth Avenue, Paterson 4, N. J.
Waldron-Hartig Div., Midland-Ross Corp., P.O. Box 531, Westfield, N. J.
L. R. Wallace & Co., 172 N. Vernon Ave., Pasadena 1, Calif.
Web Controls Corp., 318 Briarcliffe Road, W. Englewood, N. J.

Screws, Extruder

Aetna-Standard Div., Blaw-Knox Co., c/o Hale & Kullgren, Inc., P.O. Box 1231, Akron 9, O.
A1-Be Industries, 9516 Rayo Street, South Gate, Calif.
JMC Co., 90 Elizabeth Ave., Elizabeth, N. J.
Johnson Mfg. Co., Inc., Highway 178, Chippewa Falls, Wis.
Killion Tool & Mfg. Co., 56 Depot, Verona, N. J.
Sawaga Manufacturing Co., Inc., 305 State Street, Trinidad, Colo.
Skyline Industries, Titusville, Pa.
Wayne Machine & Die Co., 375 Broadway, Passaic, N. J.

Slitters

Abbott Plastic Machine Corp., 7124 N. Clark St., Chicago 26, Ill.
A1-Be Industries, 9516 Rayo Street, South Gate, Calif.
Appleton Machine Co., Doven Div., 618 S. Oneida Street, Appleton, Wis.
Charles Beck Machine Corp., 66 Church Road, King of Prussia, Pa.
Black-Clawson Co., Dilts Div., 46 N. First Street, Fulton, N. Y.
Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pa.
I. G. Brenner Co., 32 E. North Street, Newark, O.
Buss Machine Works, Inc., 300 Eighth Street, Holland, Mich.
Cameron Machine Co., Franklin Road, Dover, N. J.
Comet Industries, 9865 Franklin Avenue, Franklin Park, Ill.
Conapac Corp., 120 E. 13th Street, New York 3, N. Y. (U.S. & Canadian Dist. for Hydro-Chemie, Ltd.)
Cumberland Engineering Co., Inc., P.O. Box 216, Providence 1, R. I.
John Dusenbery Co., Inc., 271 Grove Avenue, Verona, N. J.
Eastman Machine Co., 779 Washington Street, Buffalo 3, N. Y.
Falls Engineering & Machine Co., 1734 Front Street, Cuyahoga Falls, O.
G & S Label Corp., 49 West 27th Street, New York 1, N. Y.
Gane Bros. & Lane, Inc., 1335 W. Lake Street, Chicago 7, Ill.
Heinrich Equipment Corp., (US Rep. for Reifenhauser Plastics Machinery Corp.), 111 Eighth Ave., New York 11, N. Y.
Hobbs Mfg. Co., 26 Salisbury Street, Worcester 5, Mass.
Inta Roto Machine Co., Inc., P.O. Box 454, Richmond 3, Va.
Oscar L. Judelshon, Inc., 148 Green Street, New York, N. Y.
Leedpak, Inc., 24 West 58 Street, New York 19, N. Y.
Liberty Machine Co., Inc., 275 Fourth Avenue, Paterson 4, N. J.
H. Maimin Co., Inc., 575 Eighth Avenue, New York 18, N. Y.
Mereen Johnson Machine Co., 4401 N. Lyndale Ave., Minneapolis 12, Minn.
Robbins Plastic Machinery Corp., 1430 Mishawaka Street, Elkhart, Ind.
Ruf Machine Co., Inc., 416 E. 93rd Street, New York 28, N. Y.
The Alexander J. Shannon Co., 150 Broadway, New York 38, N. Y.
Skil Corp., 5033-43 Elston Ave., Chicago 30, Ill.
Stanford Engineering Co., Box 329, Salem, Ill.
Swan Machine Co., 320 Fifth Avenue, New York 1, N. Y.
Turner Tanning Machinery Co., 65 Walnut Street, Peabody, Mass.
Web Controls Corp., 318 Briarcliffe Rd., West Englewood, N. J.

Spooling Equipment

A1-Be Industries, 9516 Rayo Street, South Gate, Calif.
Vern Emery Co., 10647 Wixom St., Sun Valley, Calif.
Entwistle Mfg. Corp., 1475 Elmwood Ave., Providence 7, R. I.
Faeco Machine Co., Inc., 643-21st Ave., Box 6, Paterson, N. J.
Foster & Allen, Inc., 26 Commerce St., Chatham, N. J.
Heinrich Equipment Corp., (US Rep. for Reifenhauser Plastics Machinery Corp.), 111 Eighth Ave., New York 11, N. Y.
Hobbs Mfg. Co., 26 Salisbury Street, Worcester 5, Mass.
JMC Co., 90 Elizabeth Avenue, Elizabeth N. J.
C. A. Litzler Co., Inc., 235 Brookpark Rd., Cleveland 9, O.
Modern Plastic Machinery Corp., 64 Lakeview Ave., Clifton, N. J.
Omni Products Corp., 460 Park Ave., St., New York 16, N. Y.
Progressive Machine Co., Inc., 167-169 E. 31st Street, Paterson 4, N. J.
Robbins Plastic Machinery Corp., 1430 Mishawaka Street, Elkhart, Ind.
Ruf Machine Co., Inc., 416 E. 93rd St., New York 28, N. Y.
Web Controls Corp., 318 Briarcliffe Rd., W. Englewood, N. J.

Take-Away Equipment

Acme Machinery & Mfg. Co., Inc., 500 Saw Mill River Road, Yonkers, N. Y.
Adamson United Co., 730 Carroll Street, Akron 4, O.
A1-Be Industries, 9516 Rayo Street, South Gate, Calif.
Associated Equipment Corp., 209 Pacific National Bank Bldg, Bellevue, Wash.
Battenfeld Corp. of America, 959 W. Grace Street, Chicago 13, Ill.
Brown Machine Co., 110 Pierson Street, Beaverton, Mich.
Continental Machinery Co., Inc., 261 Broadway, New York 7, N. Y.
Davis-Standard Div., Franklin Research Corp., 12 Water Street, Mystic, Conn.
John Dusenbery Co., Inc., 271 Grove Avenue, Verona, N. J.
Frank W. Egan & Co., 671 S. Adamsville Rd., Somerville, N. J.
Entwistle Mfg. Corp., 1475 Elmwood Ave., Providence 7, R. I.
Faeco Machine Co., Inc., 643-21st Ave., Box 6, Paterson, N. J.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Farris Universal Machine Corp., 400 Commercial Ave., Palisade Park, N. J.
Foster & Allen, Inc., 26 Commerce Street, Chatham, N. J.
Goulding Mfg. Co., 2929 River Street, Saginaw, Mich.
H & T Machine Works, 11365 Humble Road, Houston, Tex.
Heinrich Equipment Corp., (US Rep. for Reifenhauser Plastics Machinery Corp.), 111 Eighth Ave., New York 11, N. Y.
Hobbs Mfg. Co., 26 Salisbury Street, Worcester 5, Mass.
Island Equipment Corp., 1090 E. 31st Street, Hialeah, Fla.
JMC Co., 683 Frelinghuysen Ave., Newark 5, N. J.
Johnson Mfg. Co., Inc., Highway 178, Chippewa Falls, Wis.
Killion Tool & Mfg. Co., 56 Depot, Verona, N. J.
Liberty Machine Co., Inc., 275 Fourth Ave., Paterson 4, N. J.
C. A. Litzler Co., Inc., 235 Brookpark Rd., Cleveland 9, O.
Modern Plastic Machinery Corp., 64 Lakeview Avenue, Clifton, N. J.
Mount Hope Machinery Co., 15 Fifth Street, Taunton, Mass.
Omni Products Corp., 460 Park Ave. S., New York 16, N. Y.
Plastic Fabricants, Div. of The Woodman Co., Inc., 647 E. College Ave., Decatur, Ga.
Plastimaster Co., 11365 Humble Rd., Houston 16, Tex.
Prodex Corp., King George Road, Fords, N. J.
The Rainville Co., Inc., 839 Stewart Ave., Garden City, N. Y.
Reliable Rubber & Plastic Machinery Co., Inc., 2014 Union Turnpike, No. Bergen, N. J.
Robbins Plastic Machinery Corp., 1430 Mishawaka St., Elkhart, Ind.
Servospeed Div., Electro-Devices, Inc., 4-6 Godwin Ave., Paterson, N. J.
The Alexander J. Shannon Co., 150 Broadway, New York 38, N. Y.
Sherman Rubber Co., Div. of Botwinik Bros. of Mass., Inc., 2 Sherman St., Worcester 1, Mass.
Sterling Extruder Corp., 1112 Baltimore Ave., Linden, N. J.
Waldron-Hartig Div., Midland-Ross Corp., P.O. Box 531, Westfield, N. J.
Web Controls Corp., 318 Briarcliffe Rd., W. Englewood, N. J.

Wire-Coating Equipment

A1-Be Industries, 9516 Rayo Street, South Gate, Calif.
Davis-Standard Div., Franklin Research Corp., 12 Water St., Mystic, Conn.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Frank W. Egan & Co., 671 S. Adamsville Rd., Somerville, N. J.
Hartig Extruders Div., Midland-Ross Corp., 1137 Globe Ave., Mountainside, N. J.
Industrial Ovens, Inc., 13825 Triskett Rd., Cleveland 11, O.
Johnson Machinery Co., 90 Elizabeth Avenue, Elizabeth, N. J.
C. A. Litzler Co., Inc., 235 Brookpark Rd., Cleveland 9, O.
Michigan Oven Co., 415 Brainard St., Detroit 1, Mich.
Modern Plastic Machinery Corp., 64 Lakeview Ave., Clifton, N. J.
Omni Products Corp., 460 Park Ave. S., New York 16, N. Y.
Prodex Corp., King George Road, Fords, N. J.
The Rainville Co., Inc., 839 Stewart Avenue, Garden City, N. Y.
John Royle & Son, 10 Essex Street, Paterson 3, N. J.
Sterling Extruder Corp., 1112 Baltimore Ave., Linden, N. J.
Douglas C. Whitaker Co., Box 271, Glenside, Pa.

Why an american plastics institute?
(*Continued from page 52*)

turns. More than half of those who have replied as this is written are in favor of the Institute. But there are some who apparently still have reservations as to whether such an Institute is really necessary.

"Can't this be done within the framework of existing bodies, like the SPE, the SPI, and the Manufacturing Chemists Association?" they ask.

The answer is: these bodies are not now doing what the proposed Institute will do; nor are they suitable instruments for accomplishing its objectives. It is not the normal function of a trade association, like the SPI or the MCA, to carry on scientific research. It is beyond the resources of a professional association, like the SPE to establish and support the educational program which is badly needed, much less the program of basic research.

It is true that the MCA has made a modest beginning by sponsoring a certain amount of research at a few educational institutions. But, on the whole, we feel that all fair-minded observers would agree that a large gap exists in these two areas—research and education—in which the program of the proposed Institute would not duplicate any function nor overlap any activity of any of these existing bodies.

Nor would its research program duplicate the extensive activities that are already being carried on by the major suppliers of plastics materials. These are devoted, in the main, to these firms' individual proprietary interests, and to application research.

By contrast, the research program of the Institute would be undertaken along lines which would fulfill the needs and benefit the common interests of all of its members. Primarily, it would call for fundamental basic research on the physical properties of plastics materials and their relation to chemical structure. If this does not sound glamorous enough to warrant all this energy being expended, consider that even after all these years there is still disagreement within the industry on methods of determining the physical properties of plastics. Development of unbiased, authoritative standards by an American Plastics Institute would be just the beginning of ways in which its research would yield useful information of universal value to members in all segments of the industry.

The smaller firms in the industry—the molders, the equipment-builders, the processors, most of the end-users—cannot afford, individually, the research needed to produce these findings. Yet their needs for this information, in order to develop successful application techniques and efficient processing methods, are just as acute. And their success impinges on the success of all the other firms in the team.

As a result of the industry's concentration on applied research, to the neglect of basic pioneering, gaps are appearing in the industry's store of fundamental technical knowledge. For example, our survey of current research activity within the industry indicates the probability of a high degree of duplication of effort in analytical testing work. Eliminating this duplication by group-supported work in a Plastics Institute would mean considerable savings in manpower and time that could be applied more effectively to expand research effort in other specific areas.

And this points up another situation—the shortage of professional people is becoming increasingly acute. Clearly, this indicates a need for expanding our educational activity to increase the supply of skilled plastics engineers and scientists. This the Institute would undertake with the cooperation of one of our leading educational institutions.

In addition, there is no central originating source of technical information about plastics; one which produces and evaluates new discoveries as well as circulates the information. This gap, too, the Institute proposes to fill.

Our Committee has worked long and hard on the plans for the organization, financial support, and direction of the work of the proposed American Plastics Institute. We commend them to the industry's careful study.

And, I repeat my initial challenge:

Are you ready for maturity?

—The End

Broadwell replaces Thayer on editorial advisory board

Gordon Thayer, a member of our Editorial Advisory Board since its inception, has resigned. One of the hardest working men in the plastics industry, Gordon is being forced to curtail his outside activities which had become staggering. He was a frequent contributor to our columns, and we shall certainly miss him. At Gordon's suggestion, we approached one of his co-workers at Dow, Ted Broadwell, who agreed to take on the task. Ted is a 1952 graduate of Michigan State University and holds a B.S. in Chemical Engineering. He joined Dow that year and was assigned to the Extrusion Section of the firm's Plastics Technical Service. He devoted special attention to monofilament extrusion, and for the past two years has been responsible for all activities and developmental work in the field of blow molding.

Ted's current job title is plastics customer service engineer. He is a member of SPE and the Engineering Society of Midland (Michigan). Mr. & Mrs. Broadwell have two sons, and make their home in Midland.

ENGINEERING FORUM

Reinforced plastics

Frequently asked questions

Edited by: HARRY T. DOUGLAS*

Here are some of the questions most frequently asked by those contemplating going into the reinforced plastics' molding business, or who recently have set up shop. I condensed these into this column for general information:

Q-1. We are a small outfit designing and manufacturing by hand lay-up reinforced plastic outboard motor boats for 1961. This is our first venture along these lines. As you manufactured some of your own, what is your opinion on: (1) distinguishing design lines for each year; (2) names or model numbers for boats; (3) standard colors vs. pastels; (4) also, "Miss X Boat" contests for 1961, 1962, etc.

A-1. If you are designing r.p. motor boats for the first time, you must have lots of capital and nerve to back you in this field. There are several well-established, profit-making molders who are manufacturing boats and who have wide distribution in many parts of the country. You should study their successful campaigns for ideas. My personal opinion, based on my own experience, is: (1) I believe that a good outboard model or models should be standardized instead of following the Detroit automotive trend of presenting new styles every year. For example, if you have a Rolls-Royce or a Mercedes-Benz in your line, it will not go out of style because it is the quality of the workmanship that counts. Boating enthusiasts do not get as much annual use out of a boat as a car owner does and, therefore, a good boat should be in style much longer. A classic model can be popular today and, with its good lines, remain popular ten years from now if the workmanship is superior. (2) I favor boat names instead of numbers, as do most boat manufacturers, because names are easier to remember and can be associated with a company. Who remembers the manufacturer of Model 208 E, for example? (3) On color, you should offer a fairly good selection of standard colors and pastels within a practical economical margin. Boat dealers will be a wonderful source of information for you. Check with them. If you go color wild, you will find yourself with a yardful of tulips at the end of the boating season. (4) Not knowing what your campaign funds are for "Miss X Boat of 1961", etc., I would venture to say that this type of yearly contest would have no application if you make a few models with good lines year after year. If you prefer annual design changes in your boat line, and you have sufficient financial backing to launch such contest, go to it. These gimmick-contests are attention-getters but not always boat-sellers.

Q-2. What field has the greatest potential for reinforced plastics which hasn't been fully exploited?

A-2. The architectural field has a tremendous potential. Many of the architects and designers who should be specifying r.p. materials are still not too familiar with fiber glass laminates. More educational work should be done in this direction. The discussion period which followed a recent forum in that industry disclosed that an impressive number of architects and designers have little factual information on the subject.

Q-3. Do you know from your lay-up experience whether some other method of removing air bubbles has been perfected over the present hand squeegee process which is so time-consuming and tedious?

A-3. This method is still in current use, however archaic it may appear. We have tried other methods but find that the only sure way to get air bubbles out of a laminate is by laborious hand squeegee of the lay up.

Q-4. I bought a polyester boat with the understanding from the dealer that I didn't have to worry about barnacles adhering to the surface. I have the biggest colonies of barnacles anyone of my friends has seen. Most of them own wooden boats and have less barnacle problems than I. What can be done with this boat hull? The boat was purchased recently.

A-4. Many unscrupulous boat dealers make exaggerated claims about the advantages of reinforced plastic boats. In their anxiety to make a boat sale, they lose sight of the fact that one dissatisfied customer will spread his discontent to many other prospective boat buyers. Fiber glass boats have many more plus signs than minuses, but need care in various departments just as wooden boats do. At this point, it would

(Continued on page 72)

* Executive Vice-President, Lunn Laminates, Inc., Huntington Station, New York

Tensile-impact measurements on reinforced plastics

(Continued from page 51)

Table 8. Tensile-Impact Vs. Izod Impact Data

	Size of Pendulum	Tensile-Impact, Ft.-Lbs./Cu.In. at 17 Ft./Sec.	Izod Impact, Ft.-Lbs./In.
Premixes:			
#8	Small	2	1.8
#7	"	11	2.5
#-4-AS-2	"	12	4.2
#9	"	16	3.2
E-4-AS-1	"	18	5.9
A	"	18	9.0
4AS	"	35	5.0
4BS	"	102	12.6
Laminates:			
Glass Mat 121-A	Large	113	14.0
Glass Mat A	"	128	5.1
Glass Mat 122-A	"	160	13.5
Glass Mat E	"	172	9.3
Glass Mat/Roving B	"	294	19.5
Glass Cloth C	"	585	13.2
Nylon (as received)	"	253	1.4
(Dry)	"	160	0.7
(Saturated)	"	317	4.1

Greater differences are noted between materials subjected to the tensile-impact test than are noted in the same materials when subjected to the Izod impact test.

The degree to which the fiber-reinforcement aids in resisting impact loading is shown readily by the tensile-impact test.

The force necessary to break a material in tension decreased as the rate of loading was increased up to a testing speed of 28 inches per minute. At an impact velocity of 11 feet per second, the values obtained were lower than at 17 feet per second.

More than one scale range must be used on the testing machine to classify the entire range of plastic materials. This also is a requirement in the Izod impact test. A change in pendulum mass is necessary in both instances.

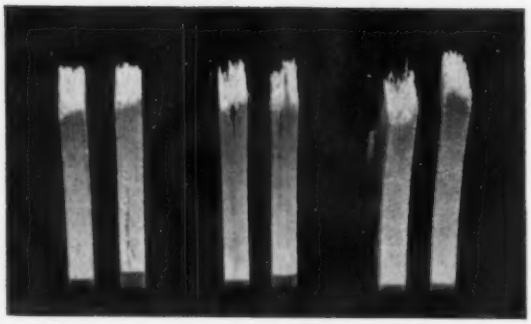

Fig. 7. Glass-reinforced laminate specimens broken by tensile-impact at a testing speed of 16 inches per minute.

The nature of the break produced during tensile-impact loading is an indication of the efficiency of the reinforcing material in resisting impact loading, and shows that a considerable volume of the specimen is stressed momentarily.

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(2). P. H. McDonald and J. A. Edwards, Eng. School Bul. #67, North Carolina State College, Raleigh, N. C. (March 1958).
(3). Maxwell and Harrington, "Effect of Velocity on Tensile Impact Properties of Polymethyl Methacrylate," TRANS. A.S.M.E., 74, 579 (1952).
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—THE END

Determining unit costs in the molding plant

(Continued from page 46)

charges. Likewise, weekly sales are not taken into account, but these figures have no bearing on production efficiency and, hence, do not affect the results.

A table such as the one illustrated, if once started by management, will serve to disclose at a glance any undue rise in manufacturing costs. Plotting of the unit-cost per dollar also will prove valuable to management when comparing present costs with those of preceding weeks, as well as showing up the differences from year to year.

Conclusions

In times such as these, with labor-cost increases occurring at an ever-accelerating pace, keeping constant watch on the actual manufacturing costs is of prime importance to all those engaged in the molding industry. Application of the method as outlined will go far toward attaining that end.

—THE END

Reinforced plastics

(Continued from page 71)

be advisable for you to have professional assistance which can be obtained from any reputable boat yard having qualified fiber glass repairmen. If you prefer to scrap the barnacles yourself and apply primer and anti-fouling paint to the hull, I suggest you get some good advice on the necessary procedure from either Glidden's Marine Division, or from Woolsey Paint and Color Co., Inc. Both offer primers and paints compatible with polyester plastics.

—THE END

PLASTICS TECHNOLOGY

EXPLORING FABRICATION TECHNIQUES

By L. J. ZUKOR, *Engineering Editor*

A method for effectively sealing Teflon . . .

. . . around a metal insert by the use of induction heating—is described by Norman Todd, chemical engineer, at DuPont's Chestnut Run Technical Service Laboratory. The technique involves the use of standard high-frequency induction heating apparatus, and is recommended whenever an extremely tight seal must be obtained. Such parts as; diodes, feed-thru terminals, and conductivity cells have been tightly sealed by this method to exclude moisture, corrosive chemicals, or other contamination.

The fit between resin and metal obtained by normal resin shrinkage in an injection molded part will often produce a satisfactory seal. When such is not the case, however, heating the metal insert to melt the resin immediately surrounding it will greatly improve the seal. Induction heating, or applying a rapidly changing magnetic field around the insert builds up heat in the metal extremely fast. FEP resin, being a non-polar dielectric material, is not affected, only the metal is initially heated. Sufficient heat is then transferred from the metal to the FEP resin in a few seconds time by conduction to cause a tight seal to form. The power input of the induction heating equipment and the time of exposure must be controlled to just melt the resin surrounding the metal insert, without distorting the FEP molding.

A successful application of this technique was accomplished on a part where leakage around metal inserts occurred at a 20 psi. pressure drop. A post-molding treatment by induction heating for about 10 seconds produced a seal which did not leak at 100 psi. before or after the part was subjected to 15 cycles going from room temperature to 300° F.

Another, involved a small cylindrical part 2-inches long by ½-inch in diameter, with a ⅛-inch diameter steel pin inserted through its center. A highly sensitive apparatus set up to measure leakage through the cylinder, along the interface between the resin and the steel pin, gave the following results. After molding, the leakage rate was 0.24 cc/hr. (tests were performed at a 40 psi. pressure drop). The leakage rate increased to 0.81 cc/hr. after the cylinder had been heated for two hours at 392° F. and cooled in air. The part was then induction heated sufficiently to melt the resin around the steel pin. No leakage was detectable after this treatment. Reheating the piece for two hours at 392° F. and following this with a dry-ice quench, showed a slight leakage rate of 0.013 cc/hr.

This technique is completely adaptable to a wide variety of sizes and shapes of molded parts. Its speed and simplicity make it attractive for use on large production applications.

—THE END

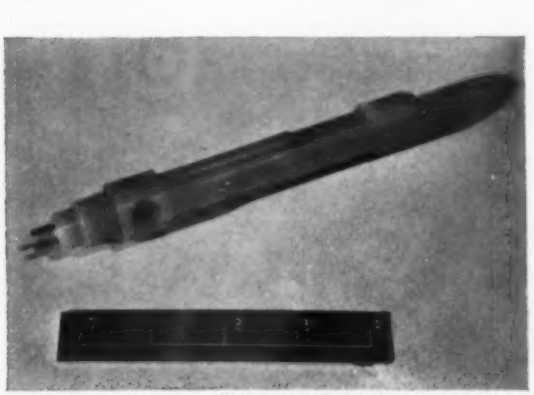


Photo courtesy: E. I. du Pont de Nemours & Co.

Leeds & Northrup Co. conductivity cell, molded by U. S. Gasket Division of Garlock Packing Co.

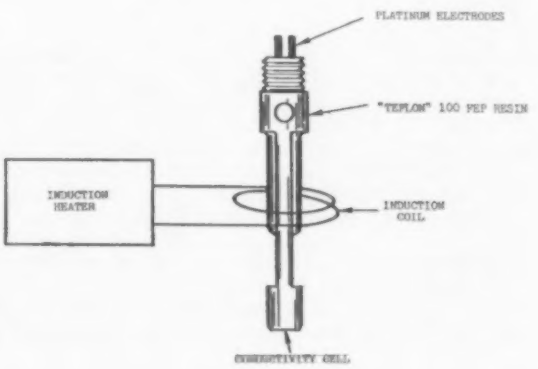
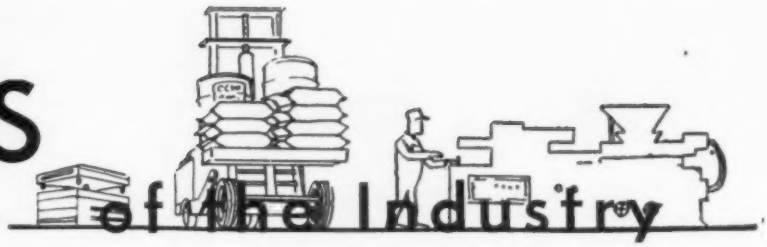


Diagram courtesy: E. I. du Pont de Nemours & Co.

Induction heating schematic. Important area to be sealed is at the ends of the electrodes within the cell.

NEWS of the Industry



business developments

Dynatech Plastics, Inc., has installed Ankerwerk automatic single-screw injection machines in its Santa Ana, Calif., custom molding plant. Ankerwerk machines operate on the screw-plastification principle.

American Viscose Corp. has increased production of its polymer resin coated cellophane by more than 50%. Four film varieties are available.

Metachem Resins Corp., Cranston, R. I., has formed the Mereco Products Division to handle all epoxy and allied resin products to the electrical and electronic industries. Divisional operations will be directed by A. M. Mello, under the supervision of H. L. Spivack.

Marvellum Co., Holyoke, Mass., has installed a 54-inch polyethylene extruder-coater designed by Waldron-Hartig Division, Midland-Ross Corp.

Poly-Fibre Association, Inc., Avenel, N. J., now offers custom filament winding of fiber glass-reinforced polyesters in addition to tanks, troughs, exhaust stacks, and fume hoods.

Cooke Color & Chemical Co., Hackettstown, N. J., has established a special color matching laboratory service. This will enable them to produce exclusive and proprietary color combinations for thermoplastics.

South American Minerals & Merchandise Corp., New York City, is currently offering antimony oxide for flame-proofing plastic materials.

Houze Glass Corp., Point Marion, Pa., now sells glass fiber materials on a direct factory basis and is expanding production facilities. Heading sales is Ray G. Beckley.

Continental Oil Co. has purchased a 25% interest in Carlon Products Corp., Aurora, O., producer of plastic pipe.

Rexall Chemical Co. and El Paso Natural Gas Products Co. have launched a joint venture for the production and sales of petrochemicals. They plan to build an olefin-polyolefin plant in Odessa, Tex.

M. Holland Co., Inc., Chicago, Ill., supplier and processor of thermoplastic materials, has formed an eastern division at 104 S. Central Ave., Valley Stream, N. Y. Albert K. Speier is vp in charge of operations.

Shell Chemical Co. has begun production of general purpose and high-impact styrene in a full range of colors. The materials are produced at American Cyanamid's plant in Wallingford, Conn.

Sonic Aviation, Los Angeles, has formed a reinforced plastics division.

Allied Chemical Corp.'s plastics & coal chemicals division is expanding its phthalic anhydride capacity at the Philadelphia plant.

Reynolds Metals Co.'s general manager of packaging sales, Paul Murphy, predicts a 67% increase in sales of transparent films (465-million pounds) by 1965. Plastic films will account for 82% of this increase.

Foster Grant Co., Inc., is operating 40 20,000-gallon tank cars, leased from GATC, to transport styrene monomer from Baton Rouge, to Leominster, Mass.

Brilhart Plastics Corp., Mineola, N. Y., is now under new management: Philip Kahn, president; and Gilbert Kahn, vice president and treasurer.

Prodex Corp. has installed high-speed equipment for extruder screw manufacturing as part of current expansion. It includes a screw generating machine, equipment for deep-hole drilling and hard-surface inlay, and tungsten-alloy finishing units.

Phillips Chemical Co. reports that demand for Marlex exceeds maximum production, and new facilities will be erected.

Crane Packing Co., Morton Grove, Ill., is producing a molding powder of Du Pont's Teflon 100 FEP filled with graphite or fiberglass.

Rogers Corp., Rogers, Conn., has acquired domestic and foreign rights and patents to Poron, a microporous PVC sheet material, from United Shoe Machinery Corp.

Kimball Mfg. Co., San Rafael, Calif., has installed what is believed to be the most completely automatic pre-forming machine on the west coast. Innovations include a vari-drive speed control mechanism with a 48-inch fan for pulling air through a pre-forming screen.

Gilman Brothers Co. has added flexible Cellulite to its line of expanded polystyrene slab stock line.

Reeves Brothers, Inc., has begun commercial production of Reevon polypropylene bristles for brush manufacture.

Interchemical Corp. offers commercial quantities of propylene imine, a cross-linking agent for polymers.

Union Carbide's silicones division now offers XR-65 Silicone, a solventless resin for high temperature insulation.

agents, distributors & agreements

Prodex Corp. has acquired exclusive manufacturing and sales rights for Granbull System blow molding machines throughout the western hemisphere except Brazil. Prodex also purchased the assets of Newark Plastic Machinery Corp., which heretofore represented Granbull Tool Co.

new plants, labs & additions

Tube Turns Plastics, Inc., is expanding its Louisville plant by about one third. This includes both a new building and new equipment.

Bee Chemical Co. recently moved from Chicago proper to the suburbs. New location is 2700 East 170th St., Lansing, Ill. The new plant has 28,000 square feet of research, manufacturing, and office space.

Polymer Corp. is building a plant in Northwestern Industrial Park, Rolling Meadows, Chicago, for plastic coating of metal products by the Whirlclad method.

Columbian Carbon Co. is constructing a plant in the Houston area for the production of carbon black dispersions. Capacity will be about 8-millions pounds annually.

Leedpak, Inc., has moved its offices from 294 Fifth Ave., to 24 West 58th St., New York City.

Preformer Boat Corp. has moved to a new 60,000 square-foot plant in Compton, Calif. The plant is set up for a continuous-flow production line.

Hysol Corp. is expanding its manufacturing and lab work areas by about one third. The plant is located in Olean, N. Y.

Formica Corp. has completed its research and development building in Evendale, O.

National Aniline Division, Allied Chemical Corp., is tripling its production of isocyanates in Moundsville, W. Va. Construction of facilities should be completed by mid-1961.

Barber-Colman Co. is expanding its plant facilities by approximately 170,000 square feet. The Rockford, Ill., firm makes automatic controls, air distribution products, and industrial instruments.

Acme Resin Corp. has added 40% manufacturing space to its Chicago plant for production of fire-resistant diallyl phthalate molding compounds.

Hooker Chemical Corp. is building a synthetic phenol plant at South Shore, Ky., to be operated by The Durez Plastics Division.

Eastman Chemical Products, Inc., is currently erecting new quarters for its sales service and product development laboratories in Kingsport, Tenn. Completion is scheduled for early 1961.

Goodyear Tire & Rubber Co. is expanding production facilities at its Niagara Falls vinyl plant at a cost of over $1-million. This will add 20-million pounds to annual capacity figures and will double capacity for Pliovics WO and AO.

Petro-Tex Chemical Corp. is building a multi-million dollar plant for the production of maleic anhydride from low-cost C_4 hydrocarbons.

Laminated Sheet Products Corp. has opened fabricating facilities at Milford, Conn.

Autotherm, Inc., has moved its plant from Fairfield to Southport, Conn.

Union Carbide Caribe, Inc., is building a polyethylene plant near Ponce, Puerto Rico. The plant will have an initial capacity of 110-million pounds.

Ferro Corp. has completed an expansion of its color division facilities in Cleveland.

Fluorocarbon Co. has moved its Santa Ana facilities to 1754 South Clementine Ave., Anaheim, Calif., which is double the size of the old plant.

Allied Chemical Corp.'s Solvay Process Division is building a plant for the manufacture of polyethers, making the firm a source for all major urethane foam components. The polyethers will be marketed by the National Aniline Division.

Phillips Chemical Co. has expanded its sales service laboratory by 4,000 square feet—a 20% increase.

Shell Chemical Co. is expanding its styrene production facilities in Torrance Calif., raising capacity to 210-million pounds annually.

American Alkyd Industries, Carlstadt, N. J., has opened a new plant at 3501 Giant Road, Richmond, Calif.

Ludlow Corp., Needham Heights, Mass., has scheduled a $750,000 expansion of its Homer, La., facilities. The firm makes cast films and plastic coated packaging.

Cordo California Corp., an affiliate of Cordo Chemical Corp., has opened a plant at 21444 West Golden Triangle Road, Saugus, Calif.

Union Carbide Plastics Corp. will have a marine terminal on Arthur Kill, Perth Amboy, N. J. Completion is scheduled for early 1961.

Ferro Fiber Glass Division has been allocated $2-million for expansion of its California plant. Bushings for drawing continuous glass fiber strands and a glass melting tank will be installed.

Plax Corp. plans to erect a 60,000 square-foot plant at Sharonville, O., a suburb of Cincinnati.

F. J. Stokes Corp. has relocated its Chicago sales office to 5875 North Lincoln Ave.

(Continued on page 81)

HERCULES

Plastics Hi-Lites

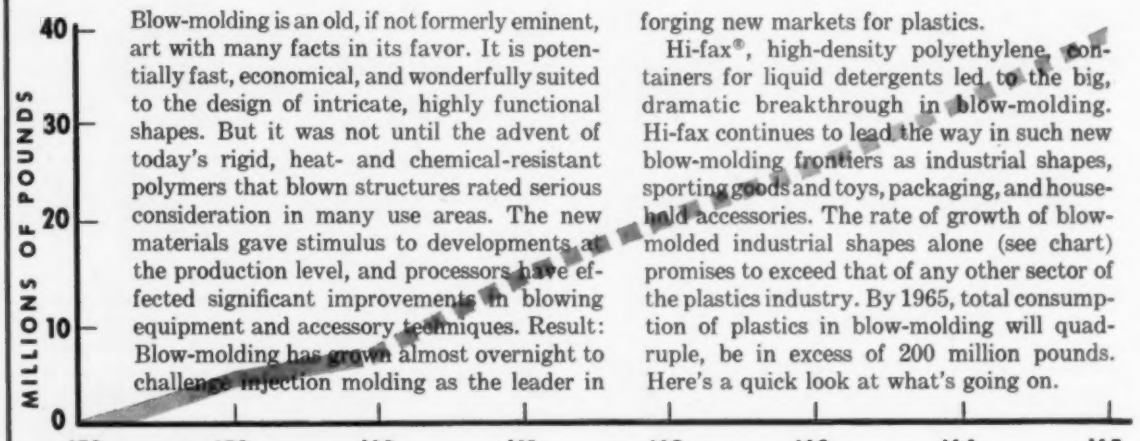
Vol. II, No. 2

Blow-Molding challenges injection

As blown containers move full steam ahead, engineers see sizeable new markets for many types of blown structures.

Blow-molding is an old, if not formerly eminent, art with many facts in its favor. It is potentially fast, economical, and wonderfully suited to the design of intricate, highly functional shapes. But it was not until the advent of today's rigid, heat- and chemical-resistant polymers that blown structures rated serious consideration in many use areas. The new materials gave stimulus to developments at the production level, and processors have effected significant improvements in blowing equipment and accessory techniques. Result: Blow-molding has grown almost overnight to challenge injection molding as the leader in forging new markets for plastics.

Hi-fax®, high-density polyethylene, containers for liquid detergents led to the big, dramatic breakthrough in blow-molding. Hi-fax continues to lead the way in such new blow-molding frontiers as industrial shapes, sporting goods and toys, packaging, and household accessories. The rate of growth of blow-molded industrial shapes alone (see chart) promises to exceed that of any other sector of the plastics industry. By 1965, total consumption of plastics in blow-molding will quadruple, be in excess of 200 million pounds. Here's a quick look at what's going on.



PROJECTED GROWTH OF BLOW-MOLDED INDUSTRIAL SHAPES

(1965 consumption of all forms of blow-molding will be in excess of 200 million pounds)

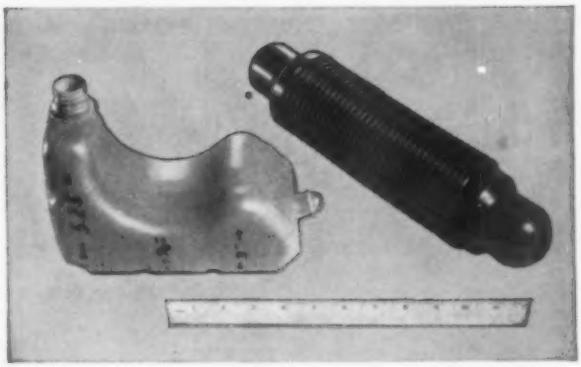
HOLD EVERYTHING?

WELL, NOT QUITE

The leading and pioneer material among the new polymers used in blow-molding is Hi-fax, high-density polyethylene. Hi-fax bottles are continually undergoing torture testing at the Hercules Plastics Applications Laboratory, where hundreds of candidates for plastics packaging have been checked out (see cut). Hi-fax won't package everything, and such testing has pointed up the few instances where the product was not compatible with plastic containers. No other high-density material has such an extensive exposure history either in the laboratory or in actual commercial use.

INDUSTRIAL SHAPES

Advanced automotive engineering concepts such as these point the way to tremendous growth in the use of Hi-fax for blown industrial shapes. The complex shape of windshield solution container (left) makes it possible to utilize former under-the-hood waste space in a compact car. Built-in bellows feature of high-density heater duct (right) provides a flexible, low-cost part adaptable to rapid, economical assembly. Both parts exemplify the fine combination of properties and processability offered by Hi-fax blown structures.



SPORTING GOODS AND TOYS

Blow-molded Hi-fax shapes offer the short, fast, low-cost route to the production of readily merchandised sporting goods and toys. Lifelike realism achieved in the duck decoy shown at left is typical of the effects possible with Hi-fax. Exciting new surface textures, excellent mold detail reproduction, and a broad color spectrum, combined with lightweight toughness, in a pleasant-to-handle, nontoxic material, make blown Hi-fax shapes a natural for these fast-moving, highly competitive markets.

DRUGS AND COSMETICS

Hi-fax has greatly broadened the horizons of designers of blown containers. Its combination of rigidity and chemical resistance now permits the use of plastic packages for a wide variety of drug and cosmetic products in exciting new shapes. Unique "Whitey the Whale" container in background holds bubble bath solution; later will serve as an appealing toy. Hi-fax blown shapes are ideal for secondary use and premium packages, at down-to-earth prices competitive with metal and glass.

HOME AND OFFICE

This handsome group of lampshades is a good example of the interesting and pleasing blown shapes which can be achieved in home and office accessories. Hardware, housewares, machine housings and decorative fittings are all fields where the esthetics and economy offered by Hi-fax blow-moldings must prompt their immediate consideration by all forward thinking producers.

Want more information about blow-molding? Look to the leader and pioneer in this field. Call or write:

CP60-5

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HI-FAX® HIGH-DENSITY POLYETHYLENE • PRO-FAX® POLYPROPYLENE • PENTON® CHLORINATED POLYETHER

HERCULES

Names in the News

Howard S. Bunn has been elected vice chairman of the Board, and **Birny Mason, Jr.,** president, of Union Carbide Corp. Both men have been on the board of directors and the appropriations committee. Mr. Bunn was elected executive vice president and member of the executive committee in 1955 and president in 1958. Mr. Mason has been executive vice president since 1958.

Samuel Loshaek has been named director of product development for Borden Chemical Co. Mr. Loshaek, who previously headed up the thermoplastics laboratory in North Philadelphia, joined the company from Rohm and Haas in 1955. **William R. Moffit** is now senior vice president for manufacturing and engineering. He has been with Borden since 1938, and for the past six years has served as vice president and technical director.

James H. Landers

James H. Landers, associated with the sales organization at Goodyear Aircraft Corp. since 1954, has been placed in charge of all commercial plastic sales. In his new assignment, Mr. Landers is responsible for sales of plastic products in all areas except the military.

William E. Gundlach, formerly of Wheeling Corrugating Co., has been designated a sales representative for the line of machine knives produced by John W. Bolton & Sons, Inc. He will cover Ohio and western Pennsylvania.

Harold W. LeBoeuf

Harold W. LeBoeuf has been named manager of manufacturing of General Electric Co.'s silicone products department. With the company since 1937, he most recently was manager of intermediates operations at the Waterford, N. Y., plant, site of all GE's silicone manufacturing activities.

William S. Aiken has been appointed director of engineering at Thompson-Ramo-Wooldridge Products Co. He has been manager of the project engineering department at the computer firm for the past year.

Robert L. Axtell and **Charles D. Smith** have been appointed plant manager and assistant plant manager, respectively, at the Moundsville, W. Va., plant of Allied Chemical Corp.'s National Aniline Division. Mr. Axtell, transferred to Moundsville as a production chemist in 1954, was promoted successively to superintendent of products, superintendent of operations, and assistant plant manager. Mr. Smith went to Moundsville in February, 1960, as superintendent of production.

Howard Primack has been added to the research and development division of Richardson Co. He will be responsible for product and process development of plastic materials.

Joseph M. Ashmore, Jr., has been appointed vice president in charge of purchasing by Tumb-L-Matic, Inc. Mr. Ashmore was formerly a research technician with S. K. F. Industries, Inc.

James R. Dudley, vice president of research and development, Richardson Co., has been elected president of the Commercial Chemical Development Association. Dr. Dudley moves up from the post of president-elect.

Thomas G. Gibian has been elected a vice president of Dewey and Almy chemical division, W. R. Grace & Co. He has been general manager of the organic chemicals division, a responsibility he retains.

R. A. Cottingham has been elected vice president and general manager of York Industrial Plastics, Inc. Before joining the company, which extrudes and fabricates thermosetting materials, he was with the aircraft nuclear propulsion research department of General Electric Co.

A. E. Wolfinger has been moved up from branch manager of New York-New Jersey operations of Richardson Co., to assistant sales manager, plastics division. **E. G. Whalen,** former field sales engineer, is now managing the New Brunswick, N.J. office, while another field sales engineer, **K. D. Rhoads,** has been named branch manager of the newly-established Philadelphia office.

Al Abrahams

Al Abrahams, manager of the central mold and engineering division of Thatcher Glass Manufacturing Co., Inc., has been moved up to the post of general manager, mold making division. **Neal Galusha,** sales engineer, has been appointed assistant to Mr. Abrahams, while **Ed Pettengill** has moved from director of the product design department to manager of sales engineering and creative design.

Samuel Ringel has been appointed marketing manager, Epoxy Products division, Joseph Waldman & Sons. Before assuming this position, in which he will manage technical sales and service, Mr. Ringel was a market development engineer with Rogers Corp.

Carl Wolff has been named vice president of sales, W. S. Shamban & Co. Since coming from National Seal division, Federal Mogul Bower Bearings, Mr. Wolff has served as western sales manager, and general sales manager.

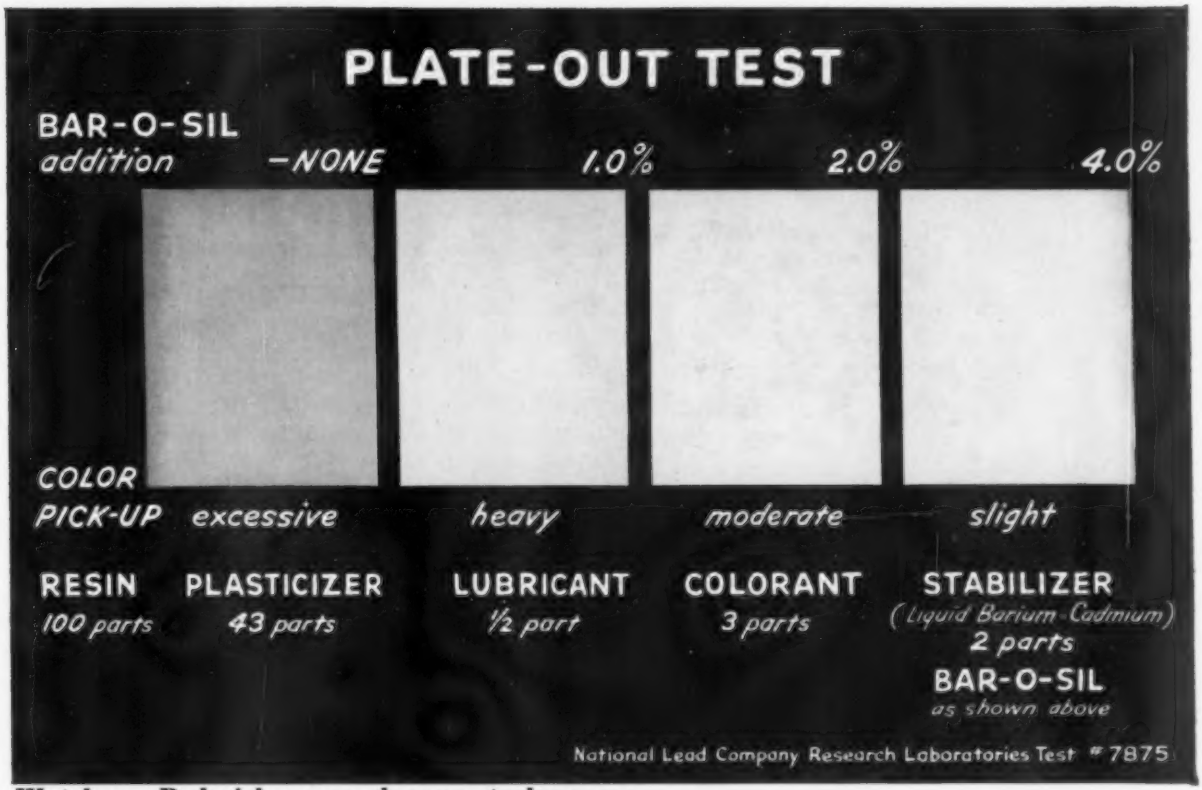
OBITUARY

Stewart Bolling

Stewart Bolling, president of Stewart Bolling & Co., Inc., Cleveland, died suddenly on August 4 at Vanderpool, Va.

An engineering graduate of Virginia Polytechnic Institute, he founded his firm in 1925. While the firm at first rebuilt used rubber processing machinery, it eventually entered upon the design and building of new equipment for rubber and plastics processing. Among its contributions to the industry is the spiral flow intensive mixer. It has continued to handle used machinery.

In recent years, Mr. Bolling devoted a portion of his time to breeding prize-winning cattle and sheep on his properties in Virginia. Services and interment took place there.



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novel new supplementary stabilizer gives best-yet control of plate-out

No need to change barium-cadmium stabilization base!

There is a standard vinyl industry test of plate-out. Recently, at National Lead Laboratories, we used it to evaluate a new and novel approach to the control of plate-out . . . with gratifying results.

Test procedure was simple. BAR-O-SIL*, a newly developed National Lead barium-silicate supplementary stabilizer, was added in varying quantities to a number of different barium-cadmium-stabilized stocks heavily overloaded with Watchung Red. Immediately after calendering each sample, a cleanup compound was run. Degree of color pick-up indicates degree of plate-out control established by given levels of BAR-O-SIL stabilizer content. In our many tests, the reduction of color pick-up has always been proportional, depending on extent of plating initially present.

Stop one production run, start the next...in minutes without cleanup

As you can see, BAR-O-SIL stabilizer provides an interesting new tool for plate-out control in barium-cadmium-stabilized stocks. Now it's practical to run color after color in quick succession.

Best of all, this unique supplementary stabilizer provides plate-out control without affecting proven (or new) stabilizations, without altering sensitive colorants, and without increasing yellowing or susceptibility to staining.

BAR-O-SIL stabilizer has several additional desirable effects . . . adds heat stability; sharply reduces hazing, crocking, spewing; controls migration of plasticizer. In calendered products, it imparts a very pleasing dry hand.

Brochure for the asking

Would you like the technical details? Use the coupon below to send for the BAR-O-SIL brochure.

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Gentlemen: Please mail me your BAR-O-SIL stabilizer brochure.

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BAR-O-SIL*
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A Chemical Development of **National Lead Company**

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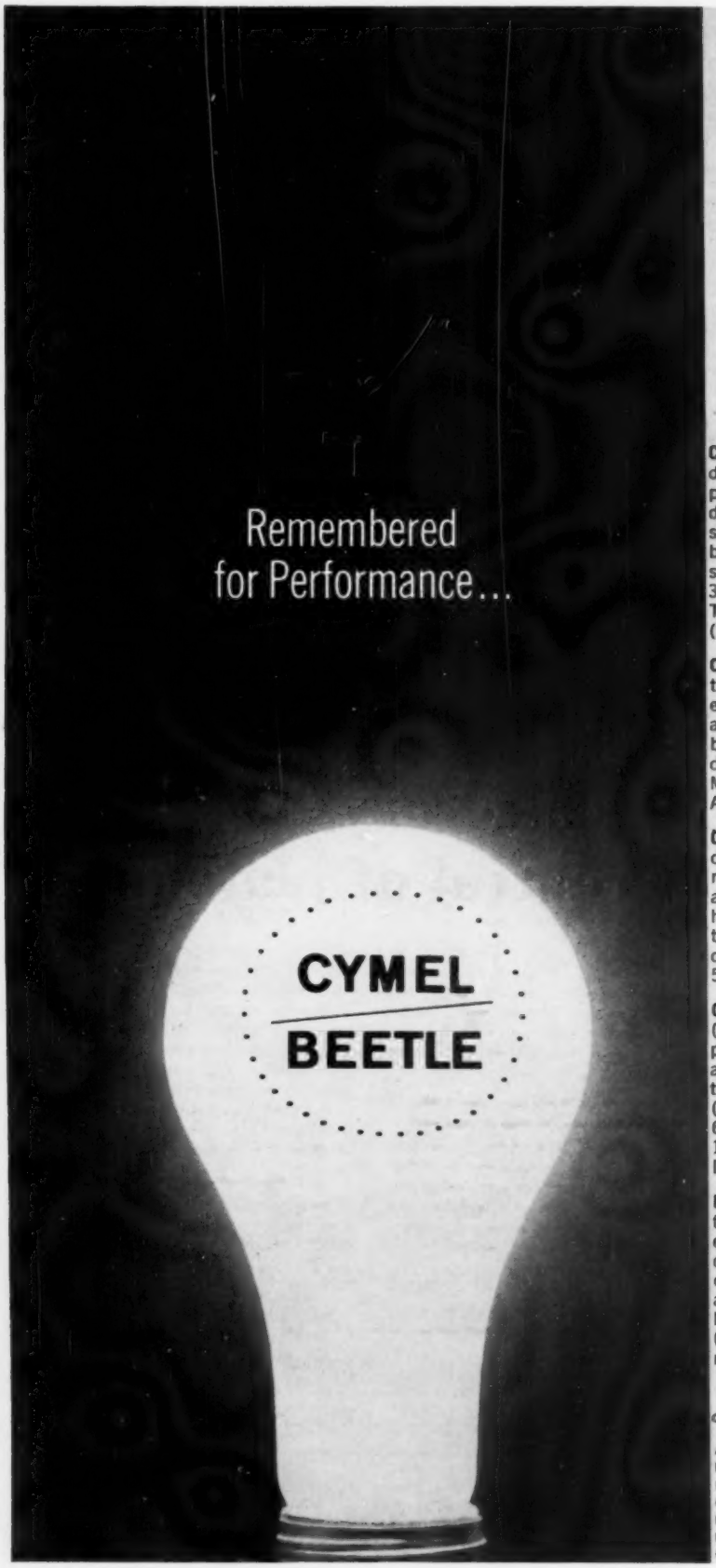

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MELAMINE

BEETLE®
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PLASTICS

CYANAMID MOLDING COMPOUNDS

SELF-EXTINGUISHING
HIGH ARC RESISTANCE
DEPENDABLE ELECTRIC PROPERTIES UNDER ADVERSE CONDITIONS
EXCELLENT ABRASION-RESISTANCE
CHEMICAL RESISTANCE

CYMEL 3135–3136 (glass-filled) Additional distinctive properties: outstanding electrical properties; high impact resistance; extraordinary flame resistance; good dimensional stability. Typical applications: circuit breaker boxes; terminal strips; connectors; coil forms; stand-off insulators. Specifications: Cymel 3135 (MMI-30, MIL-M-14E, Federal L-M-181 Type 8; ASTM D704-55T Type 8); Cymel 3136 (MIL-M-19061, MMI-5).

CYMEL 592 (asbestos-filled) Additional distinctive properties: resistance to atmospheric extremes; high dielectric strength. Typical applications: connector plugs; terminal blocks; a/c, automotive and heavy duty industrial ignition parts. Specifications: MIL-M-14E MME; Federal L-M-181 Type 2; ASTM D704-55T Type 2, SP1 SPEC NO. 27025.

CYMEL 1077 (alpha cellulose-filled) Additional distinctive properties: Surface hardness, heat resistance, unlimited color range. Typical applications: appliance housings, shaver housings, business machine keys. Specifications: MIL-M-14E – Type CMG (in approved colors); Federal L-M-181 Type 1; ASTM D704-55T Type 1, SP1 SPEC NO. 30026.

CYMEL 1500 (wood flour-filled)–CYMEL 1502 (alpha cellulose-filled) Additional distinctive properties: Good insert retention. Typical applications: meter blocks, ignition parts, terminal strips. Specifications: Cymel 1500 (MIL-M-14E Type CMG, Federal L-M-181 Type 6, ASTM D704-55T Type 6); Cymel 1502 (MIL-M-14E Type CMG, Federal L-M-181 Type 7; ASTM D704-55T Type 7.

BEETLE® UREA (alpha-filled) Additional distinctive properties: Economy of fabrication, economy of material, myriad translucent and opaque colors. Typical applications: wiring devices, home circuit breakers, tube bases, appliance housings. Specifications: Federal L-P-406A, LC 726-1, ASTM D705-55, Grade 1 (Arc resistance limits are in process of revision by ASTM), SP1 SPEC NO. 27026.

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News of Industry (Cont'd. from page 75)

changes in ownership, new companies

Zero Mfg. Co., Burbank, Calif., has purchased control in Pli-O-Seal Mfg., Inc., Pasadena. The former specializes in aluminum aircraft and electronic components; the latter in precision electronic parts molded of nylon, Kel-F, Teflon, and diallyl phthalate. Pli-O-Seal is currently moving to Burbank.

Ekco Products Co.'s Pacific Laminates Division, Costa Mesa, Calif., has purchased the assets of Laminex, Inc., same city. Both firms make reinforced plastics sports goods.

Luma Industries Co., Petaluma, Calif., is a new extrusion firm organized by Philip J. Blanchett and Orwin G. Maxson, both formerly with Dow Chemical Co. They also plan to do color compounding.

Fox Specialty Co., Inc., Lowell, Mass., is not a new company, but is new to the plastics field. Its specialty will be injection molding.

Kimball Mfg. Corp., San Rafael, Calif., and Marplex Co., El Segundo, have formed a new concern—Artline-Kimball of California. To be located in El Segundo, the company will produce reinforced plastic planters, serving pieces, and trays.

Erie County Plastics Corp. is the name of a new injection molding firm located in Corry, Pa. President and treasurer is Paul C. Roche, former vp of Nosco Plastics. William P. Hayes, also of Nosco, is vice president and plant manager.

changes in corporate name

Illinois Testing Laboratories, Inc., Chicago, becomes Alnor Instrument Co., division of Illinois Testing Laboratories, Inc.

Stolper Steel Products Corp., Menomonee Falls, Wis., becomes Stolper Industries, Inc. The firm has a reinforced plastics division, and markets many non-steel products.

general/specific

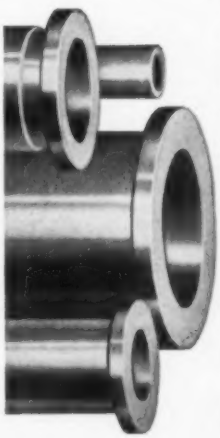
SPE's Plastics in Building PAG is currently preparing a traveling exhibit called "Plastics—A New Dimension in Buildings." It is directed toward the architect, builder, contractor, and interior designer and will be shown in a selected number of museums throughout the United States and Canada. Companies wishing to participate should contact Armand Winfield, P.O. Box 332, Hazardville, Conn.

Flo-Tronics, Inc., Minneapolis manufacturer of air conveying systems and processing controls, has just set up a research laboratory for full-scale testing of air conveying systems using any type of material.

Dow Corning Syl-off 1107 emulsion has been accepted by the Federal Food & Drug Administration as a coating for paper-packaged food products.

only Xaloy

meets every requirement in extruder cylinders



1 ... because Xaloy *bimetallic cylinders* are available in *all* sizes, engineered to meet the individual requirements of plastics and rubber processors.

2 ... because the mirror-smooth surface of Xaloy liners allows maximum production, hour after hour, in continuous service.

3 ... because Xaloy cylinders have proven to be the most advanced liners for extrusion machines over the past 25 years.

WRITE FOR NEW XALOY DATA GUIDE

INDUSTRIAL RESEARCH LABORATORIES
Division of Honolulu Oil Corp.
961 East Slauson Ave.
Los Angeles 11, Calif.

New Materials

For more information check Readers' Service Card (p. 115)

Copper-Clad Laminates

Taylor Fibre Co. has introduced two copper-clad, hot-punch, paper base phenolic laminates. Grades 320-R and Fireban 321-R, with rolled copper foil, and 320-E and Fireban 321-E, with electrolytically deposited foil, derive high insulation resistance and surface resistivity from the base stock.

Fireban 321 possesses, in addition to excellent punching and electrical characteristics, flame retardance. The 320 series is characterized by low dielectric loss, high dimensional stability, mechanical strength, and resistance to fungus growth.

The materials are offered in sheets 36 by 48 inches, 0.020 to inch thick. Base stock is translucent and can be cold punched to 1/16-inch thicknesses. Finish is semi-gloss, #4 plate. The copper foil, minimum 99.5% purity, is available on one or both sides. Rolled foil is applied in thicknesses of 0.0014, 0.0028, and 0.0042 inch; electrolytically deposited foil in thicknesses of 0.0014 or 0.0028 inches.

Average bond strength, 0.0014-inch layer of copper, is six pounds per inch of rolled foil width, and seven pounds per inch electrolytically deposited foil.

Dissipation factor, 1 megacycle, 1/32–¼ inch	0.032–0.035
Insulation resistance, 1/16 in., min. megohms	500,000
Surface resistivity, 1/16 in., min., megohms	250,000

Readers' Service Item 1

Epoxy Molding Compounds

The soft flow characteristics of EMC epoxy molding compounds make possible low pressure transfer and compression molding of electronic and electrical parts. Developed by American-Marietta Co.'s adhesives, resin, and chemical division, EMC is reported to incorporate an outstanding balance of physical, electrical, and chemical properties in a single component system. Neither outgassing nor use of mold release is necessary.

Five compounds are available. Two, EMC 8238 and 8239, are self-extinguishing. In the tabulation, range of electrical properties depends upon test temperatures. First figure is lowest temperature. All specimens were molded at 300° F. for five minutes, with no post cure.

	8230	8238	8233	8239	8237
Flexural strength, psi	—	10,000	12,100	11,100	17,800
Compressive strength, psi	—	18,200	21,500	21,300	25,500
Tensile strength, psi	6,460	6,620	8,810	8,350	9,130
Coefficient of linear thermal expansion, in./in. ° C, x 10^{-6}	3.03	2.98	2.59	2.46	1.49
Heat distortion temperature, ° F. at 264 psi	233	232	244	226	309
Izod impact strength, ft. lb./in. notch					
Face	0.23	0.31	0.44	0.48	6.16
Edge	0.18	0.31	0.48	0.43	5.11
Rockwell hardness, M scale	93	93	101	99	108
Volume resistivity, ohm-cm	1.52×10^{13}	1.78×10^{13}	1.72×10^{13}	1.87×10^{13}	4.70×10^{13}
	—	—	—	—	—
	2.72×10^{10}	4.24×10^{10}	4.54×10^{10}	5.37×10^{10}	5.89×10^{10}
Surface resistivity, ohms	3.92×10^{13}	3.92×10^{13}	3.92×10^{13}	3.92×10^{13}	3.92×10^{13}
	—	—	—	—	—
	8.63×10^{11}	1.09×10^{12}	8.44×10^{11}	7.08×10^{11}	2.79×10^{11}
Insulation resistance, ohms	2.50×10^{14}	2.50×10^{14}	2.50×10^{14}	2.50×10^{14}	2.50×10^{14}
	—	—	—	—	—
	1.75×10^{10}	4.25×10^{9}	3.40×10^{10}	6.25×10^{9}	9.30×10^{9}
Arc resistance, seconds	128–60	124–96	133	120	126–120
Dielectric strength, volts/mil, short time	387–346	326–358	304–412	326–421	344–498

Readers' Service Item 3

High-Temperature Compound

Resistotemp, a compounding of specially treated and highly refined fibrous potassium titanate with a high temperature phenolic, is available from Resisto Chemical, Inc. Known as Resistotemp, this insulation material is reported to withstand temperatures up to 6000° F. for limited periods, and sustained temperatures to 1000° F.

Other characteristics attributed to Resistotemp are high sound absorption; high dielectric constant at advanced temperatures; specific gravity of 1.6; and a low density refractory to scatter infrared radiation effectively.

The manufacturer suggests the use of Resistotemp for missile and rocket construction. Several formulations, for different temperature and chemical resistance requirements, are available. Conventional matched metal dies and ovens will suffice for molding and curing processes.

Readers' Service Item 2

Flexible Epoxy Coating

A flexible epoxy coating for circuit boards has been announced by Empcor Co. To be marketed under the name Empcote, the coating is reportedly tough, flexible, and highly resistant to moisture, vibration, and heat. It was especially compounded to permit a faulty circuit board component to be cut out with a heated knife blade, replaced, and spot-patched.

Equal mixed portions of Empcote and hardener will start to jell in about three hours and will cure at room temperature in 8-12 hours. Curing may be accelerated by heating for two hours at 150-180° F.

Readers' Service Item 4

Styrene Polyester Spray Resin

Vibrin 158-A is a lightweight, strong, styrene polyester resin designated specifically for use with spray equipment. A product of Naugatuck Chemical division, U.S. Rubber Co., the resin is reported by a reinforced plastics boat builder to have boosted production by 40% over a one year test period.

The resin will wet glass fiber rapidly, a requirement for spray applications. Further, a controlled degree of exotherm speeds curing. Since it is thixotropic, it will not sag or drain from vertical surfaces. Pot life of the resin with promoter added is several weeks at room temperature. However, Vibrin 158-A catalyzed with 2.0 parts of benzoyl peroxide has a pot life of only 48 hours at 78° F. Specific gravity of the liquid resin is 1.045.

Final properties of a glass fabric-reinforced laminate might be:

Flexural strength, psi	25,380
Flexural modulus, psi	1.5×10^{6}
Tensile strength, psi	14,800
Tensile modulus, psi	1.1×10^{6}
Compressive strength, psi	20,800
Notched Izod impact, psi./in.	14

Readers' Service Item 5

PLASTIC COATED CUPS · FOOD WRAPPINGS · FATTY FOOD CONTAINERS

WHEN YOU CAN'T AFFORD A "QUESTIONABLE" PLASTICIZER... when your plasticizer must be safe, nontoxic and economical, Pfizer Citroflex® A-4 is your best bet. ■ Especially suited for use in plastic coatings, packaging films and plastisols, Pfizer Citroflex A-4 is odorless as well as nontoxic. And it has been accepted by the Food and Drug Administration for use in packaging for both fatty and non-fatty foods. ■ CITROFLEX A-4 (Acetyl Tributyl Citrate) shows excellent results in plasticizing vinyl films for meat wrapping, vinyl coatings for food containers and hot drinks cups and vinyl plastisols for bottle crown liners and food jar sealing rings. In addition, Pfizer Citroflex A-4 is excellent in polyvinyl acetate adhesives. ■ Remember, for non-toxic, efficient, economically-priced plasticizers look to Pfizer first. ■ Write for Technical Bulletin #31, "Citroflex® Plasticizers."

USE SAFE, NONTOXIC Pfizer CITROFLEX®A-4®

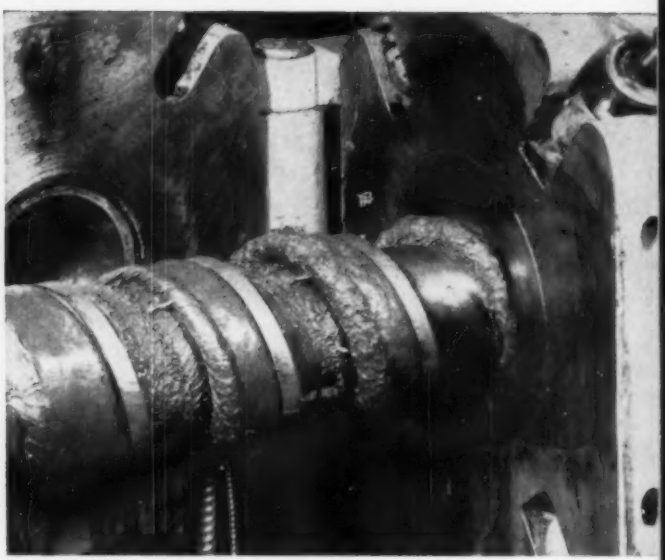
®Accepted by the F.D.A.

Manufacturing Chemists for Over 100 Years **Chas. Pfizer & Co., Inc., Chemical Sales Div.** Science for the world's well-being

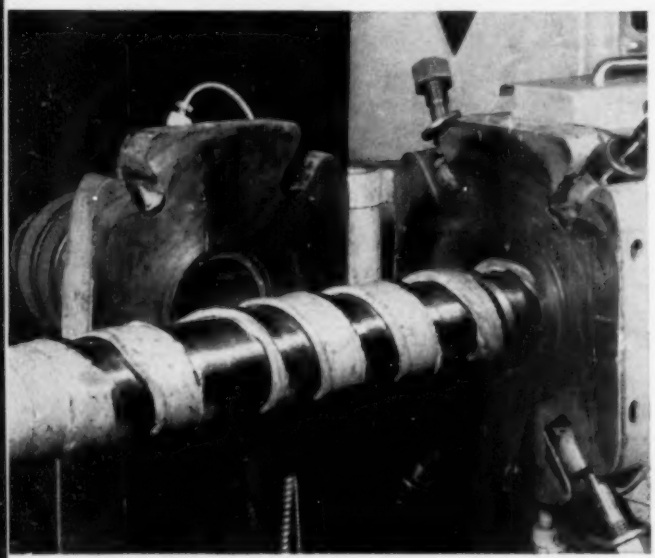
630 Flushing Ave., Brooklyn 6, N.Y. Branch Offices: Clifton, N. J.; Chicago, Ill.; San Francisco, Cal.; Vernon, Cal.; Atlanta, Ga.; Dallas, Tex.; Montreal, Can.

now...clean your extrusion or injection machine in hours...not days...with A-C Cleaning Compound

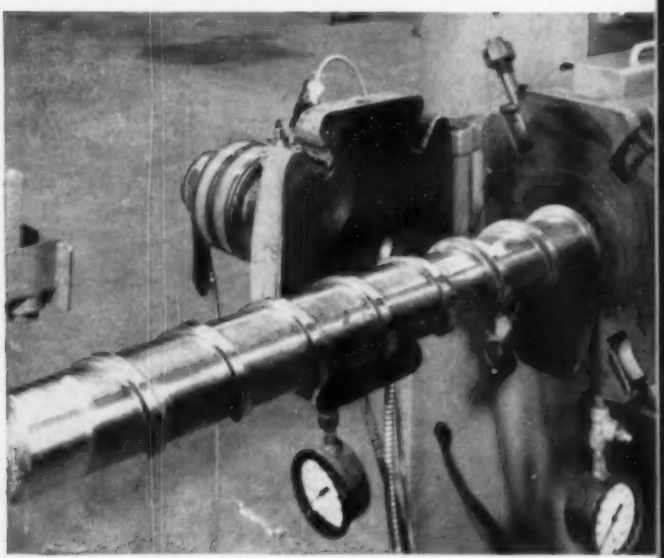
1. Empty hopper and load with A-C Cleaning Compound.



2. Operate machine to purge old material.



3. Note how A-C Cleaning Compound strips off easily.



4. In hours—not days—a clean machine ready for the next run!

If you've been losing days and dollars in making change-overs, here's good news! Allied's Semet-Solvay Petrochemical Division has now developed a cleaning compound that will completely remove any thermoplastic material—and do it in a fraction of the time normally required. The simple procedure is pictured above.

One extruder tells us that he saves $5,000 by using A-C® Cleaning Compound—cleans a machine in 1½ hours without tearing it down.

You'll find A-C Cleaning Compound speeds changing material or colors, and eliminates cylinder contamination. It purges without scratching and strips cleanly and easily from extrusion screws without mess.

For a free bulletin telling how this new cleaning compound can save *you* time and money, just write us at the address below.

Allied Chemical

SEMET-SOLVAY PETROCHEMICAL DIVISION

Dept. 578-R, 40 Rector Street, New York 6, N. Y.

National Distribution • Warehousing in Principal Cities

Polypropylene Film and Sheet

AviSun Corp. has announced commercial production of Olefane polypropylene for packaging applications. Film from one through four mils for general packaging and sheeting from four to 20 mils for thermoforming is offered in rolls from 2½ to 60 inches wide. Olefane can be treated for printing, and supplied with low slip or high slip coefficient of friction properties.

Reported to have excellent optical properties, Olefane may be impulse and radiant bar heat-sealed. Dimensional stability up to maximum use temperature is claimed to be excellent. It is insensitive to atmospheric variations, and shows excellent resistance to acids and alkalies. Typical properties include:

Specific gravity	0.885–0.895
Yield, sq. in.tlb.t1 mil	30,900–31,300
Water vapor transmission rate, gms./100 sq. in./24 hrs./1 mil	0.45–1.10
Maximum use temperature before softening, °F	300
Heat seal range, °F	350–245
Tensile strength, psi., MD	7,600
TD	4,600
Elongation, %, MD	741
TD	730
Tear strength, mod. Elmendorf, MD	82
TD	426
O_2 transmission, cc./100 sq. in./1 mil/atm	180–260
CO_2 transmission, cc./100 sq. in./1 mil/atm	586–780

Readers' Service Item 6

Tailored Polyethylene Resin

According to Phillips Chemical Co., its tailored plastic resin Marlex TR-101 yields a film superior in burst strength to lower density polyethylene of kraft multiwall bags. The resin was designed for films for industrial bag packaging as well as inflatable buildings, collapsible grain storage bins, and other non-bag uses.

Properties of a 7-mil TR-101 film are:

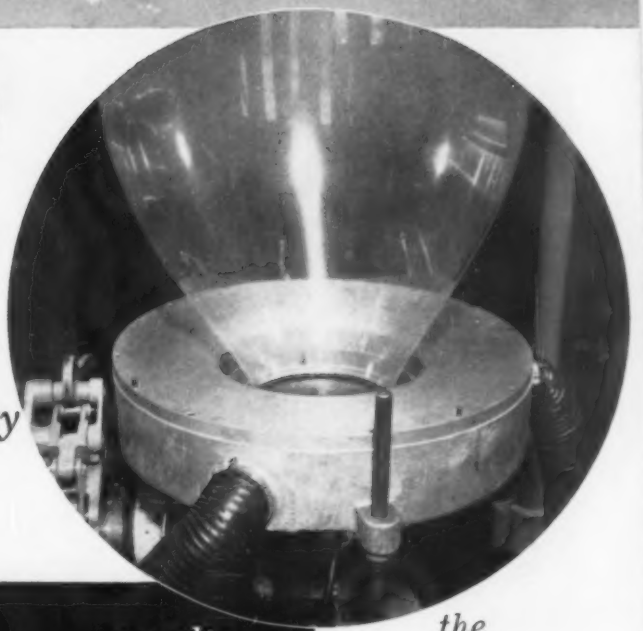
Density	0.938
Tensile strength, psi., MD	3,180
TD	3,040
Pounds pull on one in. strip	23
Elongation, %	700
Water vapor transmission, 100° F., 95% RH, gm./100 sq. in./24 hrs/mil	0.70
Actual WVT rate, gm./100 sq. in./ 24 hrs.	0.10
Use temperature, °F	> −93 to 240
Burst strength, falling ball, ft. to break 2.3 lb. ball	8
Burst strength, ft.-lb.	>18.4
Elmendorf tear strength, gms./ mil, MD	131
TD	400
Modulus of elasticity, psi.	45,000

Readers' Service Item 7

Blown Film GAUGE CONTROL?
For close-tolerance, top quality Layflat Film

1

D-S flow control superiority at the DIE



2

results in product superiority at the wind-up

the patented D-S Rotative Crosshead directs the flow of compound evenly around the die circumference for better gauge control. This rotative flow pattern assures closer tolerance control and more even film thickness around the entire bubble.

Get complete details by return mail

DAVIS-STANDARD
Division of FRANKLIN RESEARCH AND DEVELOPMENT CORPORATION
thermatic
44 WATER STREET, MYSTIC, CONNECTICUT

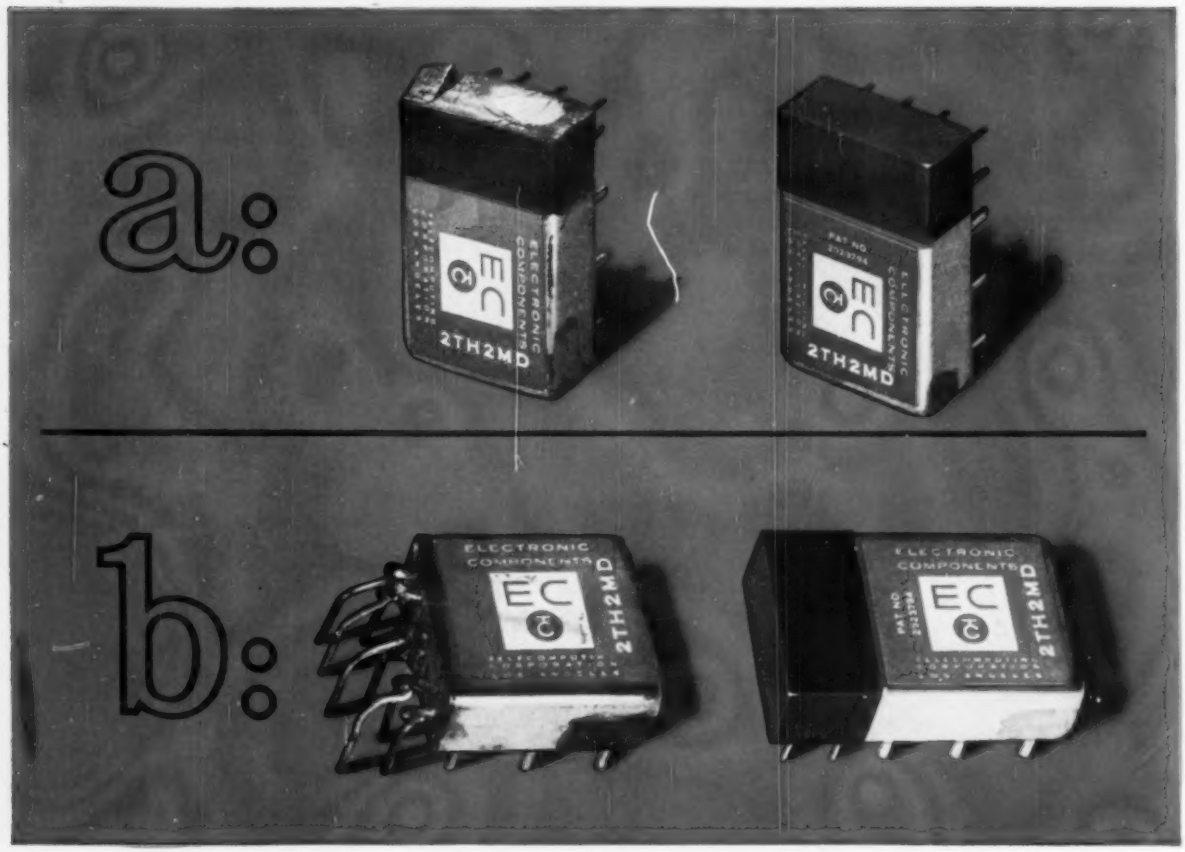
NAME _____ TITLE _____

STREET _____ STATE _____

COMPANY _____

PRECISION EXTRUSION CONTROL IS OUR BUSINESS

DOW | THERMOSETTING RESINS



TESTS PROVE DOW EPOXY NOVOLAC

outperforms conventional epoxies under extreme stress!

Potting relay terminal connectors for the guidance system of one of America's new missiles, a major electronic component manufacturer made a series of torture tests . . .

TEST a: To determine the effects of prolonged heat on two terminal relay potting formulations–one a high quality conventional epoxy resin, the other, Dow Epoxy Novolac (D.E.N. 438). Both were placed in a 180°C. oven. After five hours, the conventional epoxy resin potting cracked. But after 100 hours of continuous 180°C. heat, the potted terminal made from Dow Epoxy Novolac was unharmed!

TEST b: To compare the ability of each potting to withstand the action of high-powered degreasing solvents. The ordinary epoxy resin formulation was completely dissolved after only 48 hours in the stripper. But the potting made from D.E.N. 438 showed no significant change, even after two weeks' immersion in the same solvent!

RESULTS: Proof once again that for potting, molding, encapsulating, laminating electronic components, or for any application where performance is critical, Dow Epoxy Novolac resins can provide the extra measure of physical and chemical stability necessary for success.

New applications for the Dow family of thermosetting polymers are being uncovered every day. If your application could benefit from their hardness, toughness, dimensional stability, and chemical resistance, call your nearest Dow sales office. Or write: THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Merchandising Department 1966DT8.

See "The Dow Hour of Great Mysteries" on TV.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

Epoxy Patching Compound

To patch or resurface worn floors, Toch Brothers, Inc., recommends its RIW Epo-Tox epoxy-type resin for excellent adhesion, resistance to abrasion, and protection against most chemicals. It may be applied in any thickness, in layers as thin as ⅛ inch, without sacrifice of properties.

Available in gray, red, or green, the two-package material can be used indoors or outdoors. It can be applied by trowel or other concrete working tool. At normal room temperature, the epoxy cures so that floors can usually be used within 24 hours. Full chemical resistance is attained within a week

Readers' Service Item 8

PVC Stabilizers

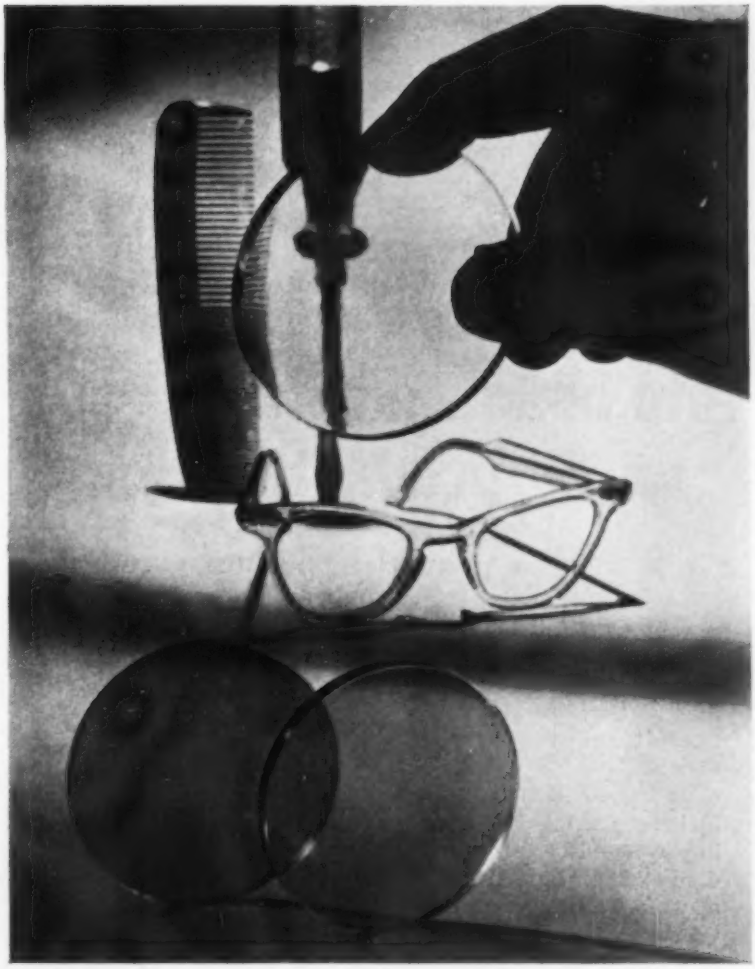
Three special purpose PVC stabilizers have been developed by Ferro Chemical to solve problems encountered in calendering vinyls and in processing plastisols and clear semi-rigid vinyls.

Ferro 2035, a white barium-cadmium powder with auxiliary organic components, is designed for use in the calendering, molding, and extruding of plasticized, pigmented vinyls. Under high temperature and high speed processing cycles, 2035 is reported to be an efficient heat and light stabilizer which provides maximum resistance to color drift and outstanding long-term heat stability. Designed to be only moderately lubricating, it minimizes plateout and resists pinking of white and light tan pigments. Compatibility is excellent.

For stabilizing clear, pigmented, and filled plastisol formulations, Ferro 1772 is recommended. A light yellow-green, liquid, cadmium-zinc stabilizer with a specific gravity of 1.01, 1772 provides resistance to plateout or mold deposits, long term light stability, clarity in unfilled formulations, good viscosity control, and good air release properties. It is not sulfur staining.

The third stabilizer is a special two component system containing barium, cadmium, and zinc in combination with organic stabilizers. Ferro 1879L, a straw-colored liquid, and 1879S, a white powder, are recommended for heat stabilizing clear, semi-rigid vinyls. In addition to heat stability, Ferro 1879L-S combinations contribute a high degree of clarity, light stability, resistance to low temperature heat discoloration, and resistance to sulfur stain. In pigmented formulations, true colors may be obtained with all types of pigments, including metallic golds and coppers.

Readers' Service Item 9



SALES-MAKING SPARKLE AND CLARITY FOR CELLULOSE ACETATE PRODUCTS

You're looking at the results of three methods of improving lacquers and molding powders with new high-quality Du Pont Cellulose Acetate.

This C/A sets a standard for sparkle and clarity. Shown above are three grades of Du Pont Cellulose Acetate: highest clarity (at top) for brilliance and sparkle, medium grade (lower right) for tinted and pigmented items, and a third grade for opaque products.

Other properties: Du Pont C/A is light stable. It is tough. It resists heat. It resists chemicals, grease, oil. It is an excellent electrical insulation.

Flaked or ground: Du Pont C/A can be supplied flaked or ground. You can have it in acetylations from 52% to 56% and in viscosities from 3 to 150 sec.

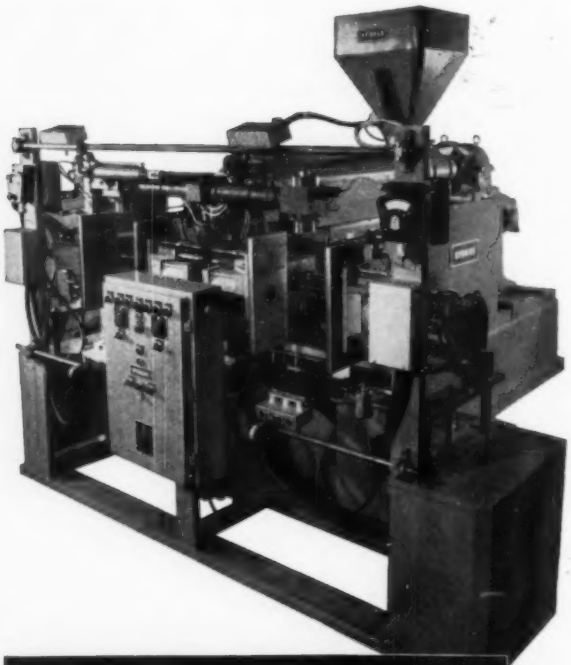
Available in 50-lb. multiwall bags.

For information on pricing and shipping arrangements, call your Du Pont representative, or write Du Pont, Explosives Department, 6539 Nemours Building, Wilmington 98, Delaware.

DU PONT CELLULOSE ACETATE

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Why the new Stokes blow molder puts more profit into hollow plastics production



- proved technique
- new simplified design
- complete unit

Stokes *completely* packaged dual-manifold blow molder brings you higher speed with flexible operation and wider versatility—at lower cost—than other units. And it's all due to this basic reason: Stokes engineers—drawing from a vast background in plastics—delivered a clean, modern, simplified design that can be used with any number of blowing methods. The new unit lowers operating and maintenance costs far below those ever before attained. Net result: higher profit margins over a wide range of products.

Convince yourself. Do you get these plus features in any other blow molder?

Full range of product sizes on a single machine—unique clamp eliminates tie bar and sliding rails in the mold area, providing a completely unobstructed flow path that makes it possible to form long, deep products. Larger open area simplifies automatic or semi-automatic removal of molded items.

High capacity and operating flexibility—you get more productive capacity than with single clamp machines, and greater flexibility than moving mold types. Dual manifold construction lets you operate one or both mold stations with either continuous or interrupted extrusion.

Completely integrated standard unit—you get a complete package including all controls, instruments, valves and operating accessories. If you already have extruding equipment, the press and manifold sections can be supplied separately.

Unusual flexibility—you can take full advantage of the blowing method best suited to your product without loss of production rate. Information regarding licenses for blowing by any of a number of methods is available.

A new four-page brochure gives you all the facts on the new blow molder. We'd like to send it to you. We're sure it will mark the beginning of a more profitable blow molding operation for you . . . write for it today.

Packaging Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.

STOKES

Silicone-Glycol Copolymer

Dow Corning's 199 silicone-glycol copolymer, developed especially for the one-shot polyurethane process, is reported to facilitate production, yield fine cell structure, and help produce low density foam. While in flexible foams it gives a high concentration of open cells, Dow Corning 199 promotes formation of closed cells in rigid polyurethane foams.

Minimum effective concentrations of the additive must be determined by test. However, a typical one-shot flexible formulation uses 0.5% by weight Dow Corning 199, and a typical rigid formulation 0.3%. It is most desirable that the additive be metered separately to the foam head, but it may also be premixed with polyglycol, toluene diisocyanate, or non-water-bearing catalysts. Shelf life of this straw-colored material at room temperature is at least six months. Other properties are:

Viscosity, centistokes, 25° C.	5,500
Refractive index	1.4435
Flash point, ° F.	350
Specific gravity, 25° C.	1.02

Readers' Service Item 10

Vinyl to Fabric Adhesive

An adhesive for laminating vinyl to fabric backing has been developed by Polymer Industries, Inc., Polybond LS-13 R4 is reported to provide excellent hand and drape, exceptional bond strength, easy machineability, and superior aging characteristics. It can be used on any type of roller coater.

Viscosity of this aqueous resin emulsion is 3,800 cps. ± 10%. The wet film, commercially free from odor, is white; it clears as it dries. Shelf life is three months.

Readers' Service Item 11

Miniature Cartridge Heaters

Hotwatt, Inc., has made available a series of cartridge heaters in ⅛-inch diameters and any desired lengths. Designed for applications where space is limited and heat requirements are high, the units operate at maximum surface temperatures up to 1,250° F. They are also useful as high temperature resistors, supplying up to 50 watts per square inch maximum density for electrical and electronic applications. The heating wire is situated near the outside surface for maximum heat transfer and minimum internal temperature while preserving good dielectric qualities.

Readers' Service Item 12

HOW THE SILICONES MAN KNOWS...

YOUR ONE-SHOT FOAM SURFACTANT IS ALWAYS UNIFORM

Every production batch of UNION CARBIDE L-520 Silicone Surfactant for one-shot polyether foams is thoroughly laboratory tested. This way, your Silicones Man can be sure it is *always uniform in the properties important for foam production.*

Tests are made on a standard one-shot foam formulation. The L-520 must meet minimum requirements for foam rise, settling at the height of the rise, foam uniformity, and freedom from splits.

True, a bench test cannot duplicate the varying production conditions encountered in plants all over the country. But it does assure you of constant uniformity in the significant surfactant properties. It has done much to help bring about widespread acceptance of the one-shot process where once there was hesitation.

For complete data, write Dept. GN-4002, Silicones Division, Union Carbide Corporation, 30 East 42nd St., New York 17, N.Y. *(In Canada:* Union Carbide Canada Limited, Toronto 7.)

UNION CARBIDE SILICONES

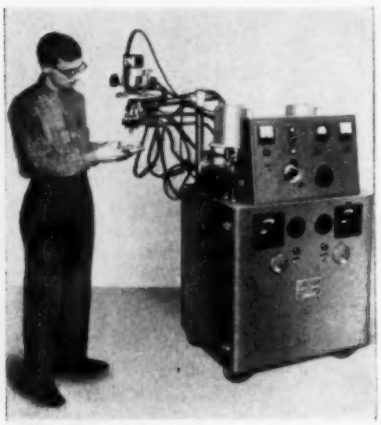
Unlocking the secrets of silicones

Rubber, Monomers, Resins, Oils and Emulsions

The term "Union Carbide" is a registered trade mark of UCC.

New Equipment

For more information check Readers' Service Card (p. 115)



Polyurethane foam equipment.

Small Size Foam Producer

The Miniature Model small shot polyurethane foam production unit will pump, meter, and mix two-component formulations for rigid, semi-rigid, or flexible foams. Mixed materials can be proportioned, dispensed, and reproduced in quantities ranging from shots of a few grams to continuous pours at 1½ pounds per minute.

Manufactured by Martin Sweets Co., Inc., the self-contained unit measures 33 by 26 by 52 inches high. It is supplied on rubber casters for portability. Two-gallon carbon steel tanks are supplied for components, and two-quart tanks for catalysts. Pumps are rotary type. Mixing head, drive, and controls are included with unit, which operates on a ¾ hp., 115/230 volt, single phase motor.

Readers' Service Item 21

Pelleting Machinery

Daffin Manufacturing Co. has made available a line of precision pelleting machines for densifying and extruding dry and low-moisture powdered, granular, and fibrous material. The machine will produce uniform pellets from ⅛-2 inches long in diameters up to 1 inch. Available singly or in packages, the pelleting machines feature a horizontal head and stationary die.

Modular design permits incorporation with other processing pieces. Interchangeable dies provide minimum power and maximum efficiency on high and low production runs. Dimensions of Daffin pelleting mills are: length, 72 11/16 inches; width, 40 inches; height, 61 inches.

Model L-40 pelleting machine.

Readers' Service Item 22

Portable Thermoformer

Atlas Vac-Machine Corp. has announced a portable thermoforming machine with a 12-inch square forming area.

Atlas Vac-Machine thermoformer.

The machine, which requires only plugging into a 110 volt outlet, has a draw up to 4½ inches deep.

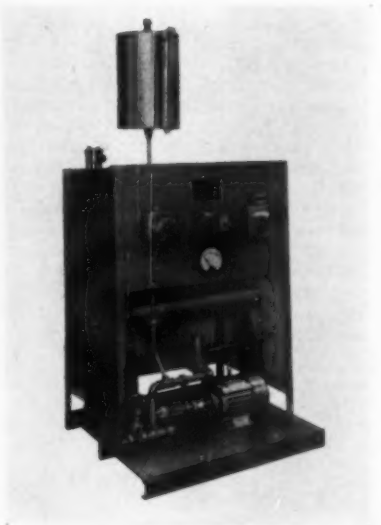
The machine, recommended for short production skin packaging and blister sampling, features sandwich heating and an up-moving platen. Maximum pressure on forming area is 200 psi. Vacuum pump will handle 0.5 cfm.

Readers' Service Item 23

Fluid Heat Transfer Systems

Radcor, Inc., has developed a series of automatic electric fluid heat transfer systems designed for simple hook-up to such processing equipment as platens, dies, and molds. Designated PF, the systems can be used with all types of heat transfer fluids.

Model PF includes, in one unit mounted on a steel base within a protective grille, a Chromalox electric immersion heater, motor and high temperature pump, bypass relief valve, strainer, expansion tank, temperature controls, contactors, and disconnect switches.



Radcor Type PF.

Model PF is offered in two sizes and ten Kw. ratings. Those with ratings of 4.5, 6, 9, 12, 15, and 20 Kw. occupy a space of 48 by 18 inches. The larger models, measuring 44 by 37 inches, are rated at 30, 40, 60, and 80 Kw. Btu outputs range from 15,350 to 272,000.

Readers' Service Item 24

Eleven-Inch Welding Torch

Laramy Products Co. has added a small, light plastic welding torch to its line of torches and tools for plastics. Designated No. 10-10, the torch is 11 inches long and weighs 11 ounces. It is designed for welding and repair of most structural plastics.

The newly-designed 350 watt, 110 volt, ceramic heating element will not burn out in the absence of airflow. Tests with current on and air supply off, lasting for an hour or more, indicated that even though the stainless steel body became red hot, and the fiberglass-reinforced polyester handle too hot to touch, the element remain undamaged. The element is reported to be resistant to shock as well as burn out. The vinyl air hose resists water, acid, and oil.

Readers' Service Item 25

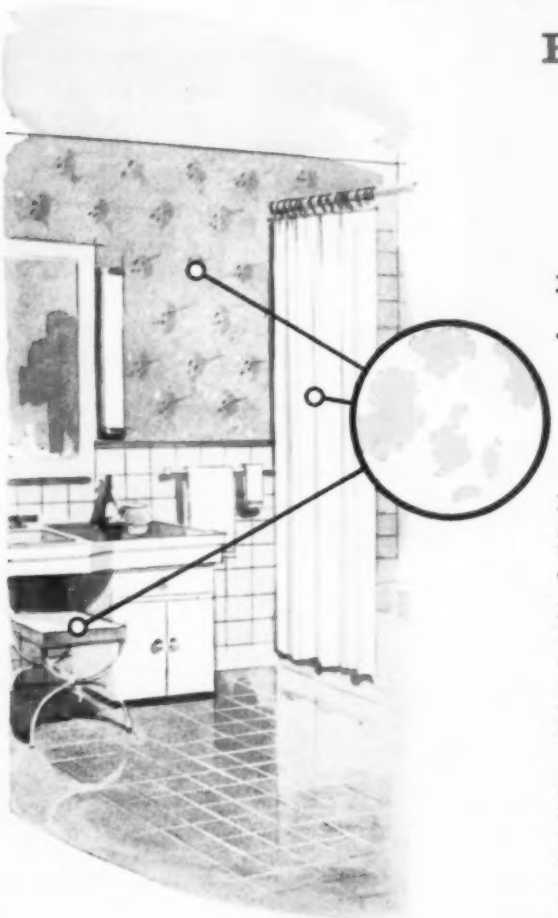
NUODEX Announces

FUNGITROL® 11

a non-metallic . . . heat-stable . . .

safe-to-use . . . non-staining

FUNGICIDE



for calendering . . . extruding . . . and other vinyl processes

Nuodex announces another new advance in its program to help producers of vinyl calendered and extruded materials to improve their products at lower cost—Fungitrol 11.

Fungitrol 11, a fungicide-bactericide, delivers a higher level of long-lasting activity than other chemicals now available. Concentrations can be reduced by as much as 50% or more to achieve equivalent protection against "pinking" and other attacks caused by fungus. Fungitrol 11 also controls a wide spectrum of bacteria.

Fungitrol 11 offers important advantages in processing. It is both heat- and light-stable, has a color superior to other fungicides, is non-staining, has low residual odor, holds side effects to minimum. It is non-metallic, non-toxic, non-irritating and, because of its extremely neutral nature, is safe for use in various types of wearing apparel.

For complete technical data, including recommended levels of concentration, and a sample of Fungitrol 11, write to Nuodex, Plastics Products Division.

NUODEX special purpose chemicals for industry

NUODEX PRODUCTS COMPANY • ELIZABETH, NEW JERSEY

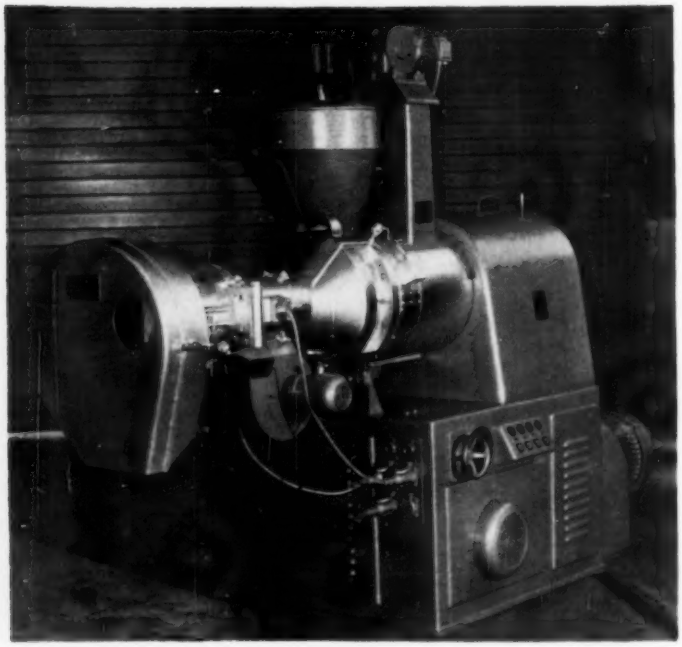
A Division of Heyden Newport Chemical Corporation

Fungicides • Nickel Salts • Organic Peroxides • Paint Additives • Stearates • Vinyl Additives

WERNER & PFLEIDERER'S

PLASTIFICATOR PK 100/V

The new continuous compounder for plasticized PVC



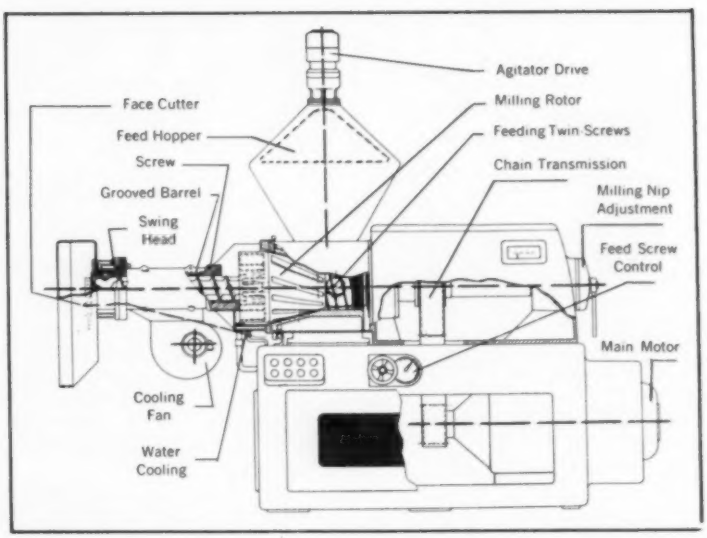
mills the preblend to greater homogeneity by passing each particle through the circumferential milling nips with the same frequency and for the same time

generates exactly the required heat by shearing stresses within the PVC controlled by stepless adjustment of the milling nips to the desired stock temperature during operation.

reduces the heat history by a shorter residence time for all particles, thus often saving half of the stabilizer

removes moisture from the preblend

densifies and extrudes the PVC at lowest temperatures into pellets of regular shape obtained by face-cutting, strand pull-off or strip dicing, at output rates of 400 to 600 lbs/hr



WERNER & PFLEIDERER CORPORATION

LA 4-1226 · 500 Fifth Avenue · New York 36, N. Y.

SUBSIDIARY OF WERNER & PFLEIDERER, STUTTGART-FEUERBACH, W. GERMANY

Insert Molding Machine

Moslo Machinery Co.'s Model 12 duplimatic molding machine permits insert molding with only one operator. By eliminating the center tie bar, this 4-6 ounce injection molding machine provides the operator access to the mold cavities. A simplified part ejector system allows greater flexibility in mold design and cavity sizes.

Model 12 Duplimatic is designed for production of electrical cord plugs, axial switches, condensers, and other plastic parts requiring inserts. It is also recommended for second color molding. Specifications of the machine include:

Cycles per hour, dry run	690
Rate of injection, cu. in./sec.	9.36–2.62
Diameter and stroke of injection ram, in.	2–8
Maximum psi. on material	20,000
Plasticizing capacity, lbs./hr.	70
Mold size, in., top half	8 x 10 x 5
Bottom half	8 x 23½ x 5
Mold opening, in.	5
Calculated mold locking force, tons	90
Mold shifting stroke, in.	13½
Mold casting area, sq. in.	40
Capacity of material hopper, lbs.	75
Injection cylinder heaters, watts	7,000
Nozzle heater, watts	300
Operating temperature of material cylinder, °F.	150–650
Heater voltage	230/3/60
Control circuit voltage	115/1/60
Motor, 230/440/550/3/50 or 60, hp.	15
Motor speed, rpm	1,200
Capacity of pump, gpm	39.1
Maximum operating pressure of hydraulic system, psi	1,250
Capacity of oil tank, gals.	77
Dimensions, l x w x h, in.	90 x 46 x 74

Readers' Service Item 26

Bench-Mounted Preheater

Reevelec Model C6C-P, the smallest preheater manufactured by Reeve Electronics, Inc., is designed for heating small preforms or loose powder prior to compression or transfer molding. The unit, designed for bench or table mounting, features a removable front panel, slide-out power supply, and detachable platens for easy cleaning and servicing.

According to the company, the amount of heat generated is a function of the material to be heated, i. e., how well the material reacts to electronic energy. In one minute, 12 ounces of average material can be brought up to desired temperature. Maximum capacity is one pound; platen area, 6 by 6 inches. The welded and buffed aluminum cabinet is 17 inches wide and deep, and 20 inches high.

Output rating at 50% duty is 1 KW; at 100% duty, 0.75 KW. Input rating is 1.8 KVA at 120 volts, 60 cycles A.C. Nominal frequency is 60 megacycles.

Readers' Service Item 27

Console Presses

Hull Corp. has added a series of console presses to complement its line of toggle and straight ram compression and transfer molding presses. The new series has 25-ton capacity. Especially designed for molding epoxies, the presses may be ordered as compression or transfer units with controls for manual or semi-automatic operation. Platen is 18 by 18 inches.

Readers' Service Item 28

Paint and Resin Air Brush

Use of the Wren air brush reportedly yields touch-up work of high quality. According to D. C. Reinforced Plastics Co., the Binks Manufacturing Co. air brush eliminates brush marks. The brush will spray polyester and epoxy resins, thinned down 10 or 15% with acetone. It is held as far away from the work as possible to dissipate the acetone and retain the original viscosity.

Readers' Service Item 29

SANDOZ
THINKS AHEAD WITH COLOR

Graphtol Yellow 4335-0

BENZIDINE-ANISIDIDE TONER

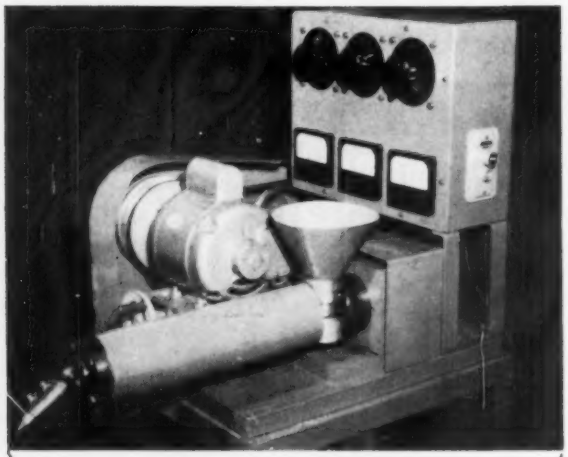
GRAPHTOL YELLOW 4335-O is a transparent, heat-resistant green shade yellow toner that is recommended for use in

Dry blending in polystyrene, polypropylene, polyethylene, nylon, etc.
Vinyl plastisols and Organisols.
Vinyl Coatings for golds, coppers, etc.
Rubber.
Floor Coverings.

General Characteristics

Transparency	Good
Strength	Excellent
Heat Stability	
For Plastic Molding Operations to 550°	Excellent
72 hours at 460°F	Excellent
Light Fastness (Masstone)	Good
Soap, Acid and Alkali Resistance	Excellent
Bleed in Vinyls	Moderate
Ease of Dispersion	
Polyethylene	Very Good
Polypropylene	Very Good
Polystyrene	Very Good
Nylon	Very Good

FOR detailed information and a color showing, call or write SANDOZ, INC., Organic Pigments Division, 61 Van Dam St., New York 13, N. Y. (ALgonquin 5-1700). Pacific Coast: Martin, Hoyt & Milne, Los Angeles, San Francisco.



Low Cost Extruder

¾" table model laboratory plastic extruder has speed variations from 10 to 112 R.P.M. will operate on either 110 or 220 V.A.C. single phase. Stand optional. Quality construction-performance manual controls.

Descriptive literature and prices on request

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Such strength of reinforcement.

Such uniformity of weight, weave and thickness.

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- ACRYLICS
- CASEIN
- POLYESTERS
- PHENOLICS (CAST)
- ACRYLICS (CAST)
- POLYPROPYLENE and other resins

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Rona Pearl Pigments are heat and light stable, non-reactive, non-corrosive, and impart high pearly luster, exceptional depth and brilliance at very lost cost.

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Write Now! A local McKesson & Robbins Chemical Department representative will be pleased to call and talk over your Organic Peroxide requirements.

Thermal Impulse Sealing Unit

Weldotron Corp.'s Sealmaster is a bench mounted and foot pedal operated unit which will seal lengths up to and including 16½ inches. Originally designed for polyethylene sealing, the unit can also be used on such films as vinyl and saran.

The unit utilizes a rapid heating and cooling action. A thin ribbon of high temperature alloy is pulsed with a high current for a short time. After the heating current is cut off, the low thermal capacity of the ribbon results in an effective reversal of heat flow.

Sealing time, depending on thickness of packaging film, is ½-2 seconds. The Sealmaster measures 21 by 8 by 8 inches.

Readers' Service Item 30

Gate Cutters

Gate cutters, designed for injection molding work, have been made available by Injection Molders Supply Co. in 6½-inch lengths. Sharply ground knife edges are flat back for close cutting of plastics. Of West German manufacture, the cutters have blades almost one inch long and leaf spring action.

IMS 6½-inch cutter.

Readers' Service Item 31

Cylinder Printer

Apex Machine Co.'s automatic cylinder printer will print one or two color decorations, trade marks, or illustrations on almost any surface. Model C-31 prints one color; Model C-32, two colors. Printing is done from one-eighth inch rubber dies on tubes up to 1½ inches, in diameter. Automatic hopper feed and conveyor take-off allow production of up to 2,500 pieces per hour.

Two ink plates ink four rollers which, in turn, ink the form. Printed copy can be up to 1½ inches wide and 4¾ long.

Readers' Service Item 32

TENITE DEVELOPMENT LABORATORY DOINGS AND FINDINGS

AGES WELL

Unless it's antique or bottled, nothing that is aged evokes much interest. To these exceptions add pipe of Tenite butyrate plastic that has been buried for seven years. A sampling of this pipe, representative of hundreds of miles of pipe now in use for carrying natural gas, was dug up for testing by Public Service of Colorado. After the dirt was washed off the outside, it looked practically as good as new. It was practically as good as new! Izod impact strength, tensile strength, % elongation and modulus of elasticity in flexure, all proved to be within the specifications of the original Tenite butyrate plastic.

When butyrate plastic pipe was first used to carry natural gas, a winery heard of it and decided to give plastic a try. Actually, the fact that Tenite butyrate pipe has a working stress of 1000 psi at 73°F. and 700 psi at 120°F., and the fact that it is economical to install, were not the only inducements; a basic factor was the unavailabiliy of conventional pipe during the war years. But butyrate proved a very happy choice . . . *in vino veritas* . . . and today this pipe continues to serve well.

If you are interested in what else pipe of Tenite butyrate can carry and where the pipe may be purchased, just drop us a line and you will hear promptly.

WHAT DO YOU SEE?

For a long time—if they thought about it at all—people were content to believe that color consisted simply of visible wave lengths at various intensities, generally expressed in terms of the three standard color stimuli: red, green and blue. Now, although the long-standing color theories of Newton, Helmholtz and Maxwell don't explain it, it is said to be possible to produce almost all colors using just two wave lengths. For example, orange light (610 millimicrons) and red light (670 millimicrons) can supposedly produce all colors except purple.

There is no telling where the new discovery will lead. On the basis of earlier concepts, aided by a spectrophotometer and tireless eyeballs, the Tenite Color Laboratory has formulated over 42,000 colors or color effects for the Tenite plastics—acetate, butyrate, propionate, polyethylene and polypropylene. And more colors are being developed every day.

Even if you don't know precisely what you are seeing, we think you will like the color match Eastman's plastics division is prepared to develop for you.

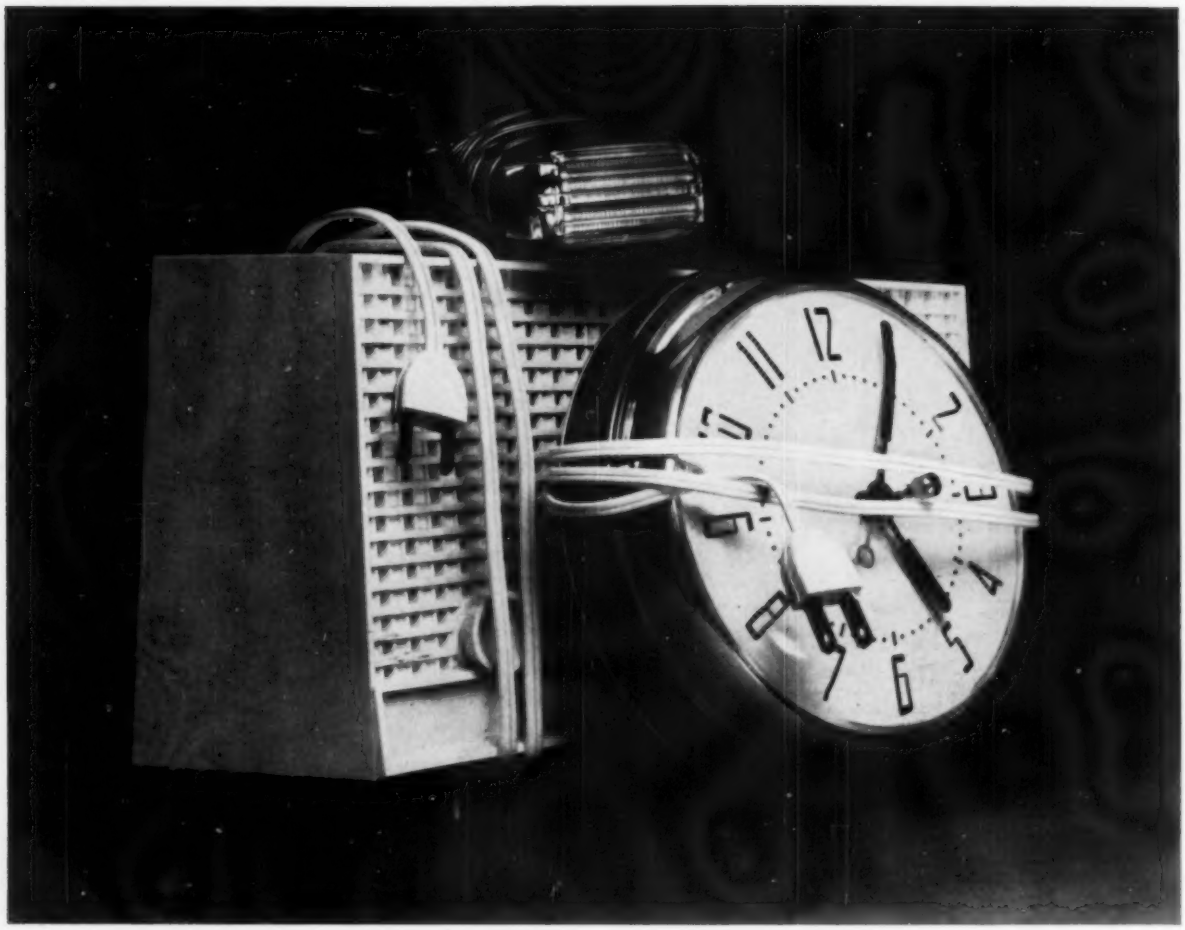
Incidentally, for coloring polyethylene with low-cost standard Tenite Color Concentrates—only 0.8¢ for coloring a pound of resin—we would suggest using a dispersion plate. Although some molders find them unnecessary, using one of these small venturi orifice plates never did any harm. Sometimes even two may be necessary. A single plate is installed simply by unscrewing the nozzle of the molding machine, inserting the plate and then replacing the nozzle. A double orifice would require drilling a small seat in the nozzle.

It might seem that a dispersion plate with a single opening only 30 or 40 mils in diameter would require considerable additional back-pressure and thus slow the molding cycle. Surprisingly enough, this is seldom the case. Try using a plate and see for yourself. However, the depth of the orifice—the land—should be no greater than 30 mils or else increased friction may cause a high pressure drop.

For color matches in polyethylene, polypropylene and the cellulosic plastics, write to Eastman Chemical Products, Inc., Plastics Division, Kingsport, Tennessee. If the color you need is not already in Eastman's file, the Tenite Color Laboratory will quickly work out a new formulation. That is how our file of more than 42,000 color effects developed.

TENITE®

plastics by Eastman



Making vinyls safe for contact with polystyrene

Would it be safe to leave these polystyrene cases wrapped in *your* vinyl-insulated wire? Or must you warn your customers against the perils of plasticizer migration?

There's one plasticizer you don't have to worry about . . . Rohm & Haas PARAPLEX G-54. PARAPLEX G-54 *stays* in vinyls. It gives your compounds excellent resistance to plasticizer migration into polystyrene, enamels, and acrylic plastics. There's no marring of finishes, no crazing of plastics.

PARAPLEX G-54 has other advantages, too. In a vinyl compound, it promotes outstanding retention of physical properties on exposure to high temperatures, imparts good resilience, resists extraction by oils, greases and soapy water, has good compatibility at high-temperature, high-humidity service conditions.

For heat and light stabilization, PARAPLEX G-54 produces excellent results in combination with the epoxy plasticizer PARAPLEX G-62. If peak electrical performance in vinyl insulation is your goal, you should also evaluate MONOPLEX S-90E.

Get complete technical information by writing for a new 23-page brochure, *Physical and Performance Properties of* PARAPLEX *and* MONOPLEX *plasticizers.*

PARAPLEX *and* MONOPLEX *are trademarks, Reg. U. S. Pat. Off. and in principal foreign countries.*

Chemicals for Industry

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

PARAPLEX G-54

Plastics Applications

For more information check Readers' Service Card (p. 115)

Multiple panel room divider.

Filigree Panels

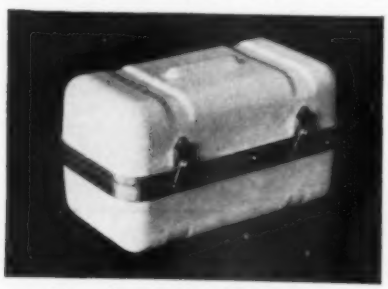
Plastic filigree screen panels, used as room dividers, floor screens, wall panels, or window shutters, reportedly enhance the decor of modern homes without sacrificing the feeling of spaciousness. Beco screen panels, manufactured and marketed by Bernard Edward Co., may be placed into single or multiple arrangements by attaching them to spring action, floor to ceiling poles.

Available in geometric or floral openwork patterns, the brightly colored panels are molded of high impact styrene supplied by Catalin Corp. of America.

Readers' Service Item 41

Containers for Airplane Parts

A sturdy, reusable container for shipment of spare airplane parts has been devised and is being produced by Thermo-Plastic Products Co. Made from Marlex linear polyethylene, the container complies with the specifications of the Air Transport Association. Boeing Airplane Co., which cooperated in the design and testing of the box, is now using it for shipment of spare parts, especially those of a fragile nature.



Thermoformed polyethylene boxes.

The container is vacuum formed from extruded sheets of Marlex Type 2, a product of Phillips Chemical Co. Corners and edges are rounded to prevent damage to contents. Containers are supplied with recesses for strapping and with or without handles.

Made in 16 sizes, the boxes are impervious to Skydrol 500 fuels, lubricating oils and greases, commonly used solvents and chemicals, and moisture.

Readers' Service Item 42

Urethane Foam Dust Guard

Standard Plastics, Inc., has announced the development of a urethane foam dust guard for railroad car journal boxes. Made from a special formulation of polyurethane foam developed by Scott Paper Co., the dust guard features outstanding resistance to temperature and oils.

Stanfoam journal box dust guard.

According to the company, the Stanfoam dust guard will also resist the pumping action of pad lubricators used in railroad car journal boxes. Thus, the guard should help to conserve oil used in journal box lubrication.

Designed by Standard Plastics and Reading Co., the Stanfoam guard is fabricated from two one-inch pieces of foam electronically welded. During the welding process, 50% of the foam is converted into a tough skin which provides the necessary toughness, abrasion resistance, and sealing qualities. Tests by Reading showed the foam guard resists temperatures up to 390° F., and remains resilient to give a tight fit around the axle.

Readers' Service Item 43

Plastic Caps for Steel Bolts

Capping steel bolts with a durable and corrosion-resistant plastic can extend their usable life under chemically corrosive conditions. Clear-Cite Products is capping steel bolts for use in glass-lined steel silos with an ABS plastic.

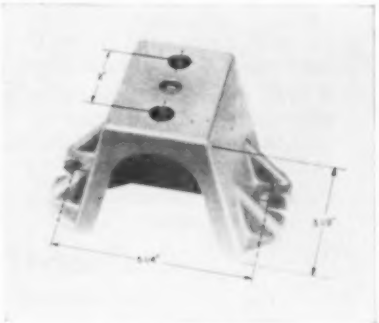
A. O. Smith Co. found that the stainless steel for bolts in their silos had to be very expensive because the juices formed by silage are highly corrosive. The stainless steel-topped bolts also required use of asbestos gaskets to make a tight seal. The first plastic tested for capping failed because it was squeezed off the underside of the head when it was tightened with the 30 pounds of torque required in silo building. This problem was solved by the use of Kralastic MM, an ABS produced by Naugatuck Chemical division, U. S. Rubber Co., which resists cold flow under loads. Although only a fraction of an inch of plastic is molded over the bolt head, it proved strong enough to resist the high torque.

The bolts are also being considered for use in wiring devices, metal plating tanks, and other steel fabricating applications where rust or corrosion is a problem.

Readers' Service Item 44

A-Frame Insulator

Glastic Corp. has announced production of a fiberglass-reinforced polyester A-frame insulator, particularly applicable for high current bus or rail support and in apparatus requiring a rugged insulator. It was designed with an 8¾ square inch top mounting area and a wide base (5¼ inches between bolt centers) for high cantilever strength. The base is fastened with ½-inch bolts and nuts. The insulator is 3¼ inches high.



Rugged RP insulator.

Readers' Service Item 45

Fiberglass-Aluminum Doors

Many home owners are finding that lightweight sectional overhead garage doors of translucent fiberglass-reinforced plastic panels mounted on extruded aluminum framing are superior to the older wooden ones. According to Frantz Manufacturing Co., makers of the Filuma door, the panels guarantee a weatherproof, shatterproof, maintenance free exterior, and an interior brightened by diffused daylight. Made in ten sizes, for single and double width openings, the doors run on semi-enclosed rollers on a vertical track.

Filon Plastics Corp. supplies the panels in white, coral, yellow, tan, and green.

Readers' Service Item 46

Polystyrene Planters

Planters claimed to keep soil sweet longer, and allow free breathing for improved plant life, are the latest items offered by Robin Manufacturing, Inc. Molded of Dylite expandable polystyrene, a product of Koppers Co., Inc., the planters are decorative as well as practical. Each of the three models has its own brass-plated stand.

The jardiniere planters, available in two sizes, are suited for wide leafed foliage.

Robin Manufacturing, Inc.'s planters.

The smaller rectangular type may be used for floral arrangements or window-sill plants.

Readers' Service Item 47

Slotted Terminal

A feed-thru Teflon terminal with a 0.030-inch diameter hole has been made available by Sealectro Corp. Designed for use in header applications in potted components, the unit is particularly suitable for potentiometer requirements.

The slotted terminal top facilitates bringing lead through the terminal for wrap-around connection. Designated RFT-SM-40-SL, the terminal is claimed to be superior to glass-bead types when complete hermetic sealing is not required.

Readers' Service Item 48

Polyethylene Drum Faucet

A two-inch polyethylene drum faucet called the Flo-King (Jumbo) has been introduced by Multi-Meter Corp. It will empty a 55-gallon drum of average material in a little more than two minutes at full flow. It will handle rather viscous materials.

Instant flow is obtained by a one-half turn of the handle. Vertical ribs inside the spout eliminate dribble and spit. Overall length in closed position is six inches.

Each Flo-King (Jumbo) is fitted with a polyethylene spout closure to eliminate residual drippage.

Readers' Service Item 49

DISTRIBUTORSHIP WANTED

We are a medium sized German refined steel company employing approximately 100 persons. Our manufacturing program includes the production of all types of alloyed and unalloyed refined steel, as required by industry.

In order to complete our sales program we are looking for a capable company in the plastics processing industry which manufactures parts used in the building of heavy machinery or similar sectors.

A well organized staff of salesmen is available for the distribution of these products. In addition, ample warehousing and storage facilities are available.

Companies interested in cooperating with us should contact:

GEBR. HOEVER
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QUALITY CONTROL

Testing Machines for
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- DEVELOPMENT
- QUALITY CONTROL

ISN'T IT TRUE?

The technical man well knows that the prudent selection of a quality control test helps maintain high product standards and eliminate costly rejections.

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- Distributors
- Custom Designing
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- Calibration

1079 Testing Machines available from TMI. Ask for our New 224 Page Catalog and Register of Testing Machines.

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72 Jericho Turnpike, Mineola, New York, U.S.A.
"Our Forty-second Year"

the few extra pennies that buy next year's vinyl business

We believe that these few pennies, invested in the right plasticizer, buy next year's vinyl business . . . the repeat business that stems from confidence in the consistent quality and performance of your product.

Why? Because these few additional pennies buy a proven low-temperature winner . . . Plastolein 9058 DOZ. We'll admit that cheaper low-temperature plasticizers appear tempting. But do they warrant putting the future of your business in jeopardy?

With time-tested Plastolein DOZ you are sure of lasting low-temperature flexibility . . . excellent heat and light stability . . . low volatility . . . unusually good "hand" . . . all the qualities that lead customers to buy (and buy again) with confidence. Isn't this your strongest appeal for next year's vinyl business . . . your best assurance of continued profit?

If you are not familiar with Plastolein 9058 DOZ, send for evaluation samples or full information today. Write Dept. 000.

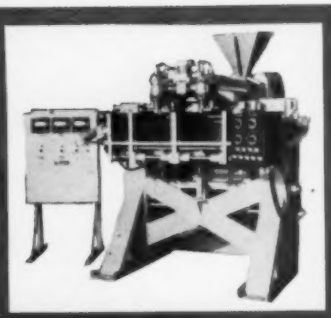
PLASTOLEIN® PLASTICIZERS

Emery

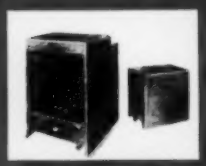
ORGANIC CHEMICAL SALES DEPT., EMERY INDUSTRIES, INC., CAREW TOWER, CINCINNATI 2, OHIO

VOPCOLENE DIVISION, LOS ANGELES — EMERY INDUSTRIES (CANADA) LTD., LONDON, ONTARIO — EXPORT DEPARTMENT, CINCINNATI

TRICO Temperature Control Units



TRICO Blow Molding Machines

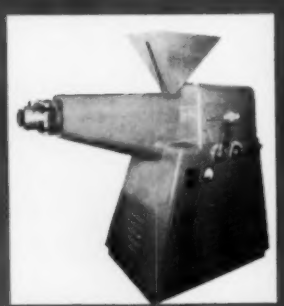


ACME Refrigeration and Recirculation Systems for Injection Molding Machines

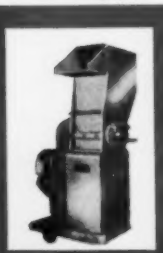
ACME Double End Blenders ¾ H.P.

NATCO Injection Molding Machine 16 to 80 oz.

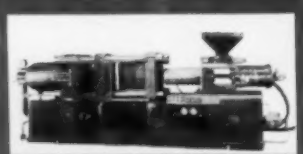
(Exclusive Dist. for New England, New York and New Jersey)



NEGRI BOSSI Extruders with American Controls



ACME By-The-Machine Granulators in 1½, 2, 3, 5 H.P.



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ACME Ovens 5 to 20 Draws

and . . . COLSON Die Lifts, WEST Pyrometers, Hopper Loaders and Dryers

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YOnkers 5-0900

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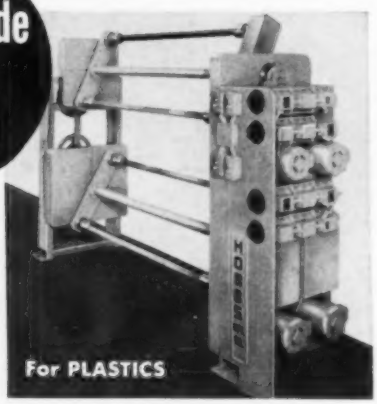
Worcester · Massachusetts
PLeasant 7-7747

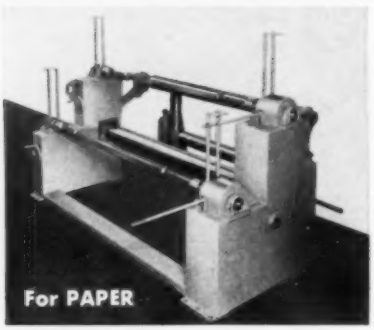
HOBBS

Web Winding Machines

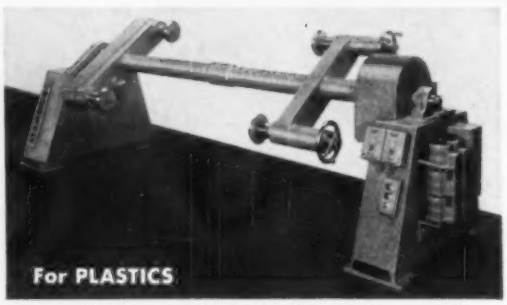
Tailor-Made for the Job



Double Turret Extruder Winding Machine specially designed for prominent plastics manufacturer.



Staggered 2-Shaft Winding Machine specially designed for nationally known tag and label manufacturer.



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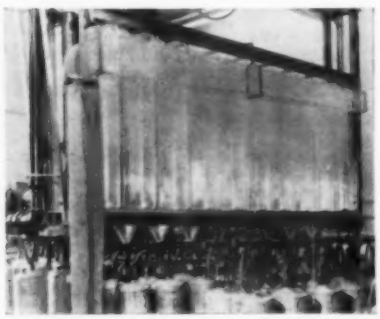
143-9

Acrylic Tanks

Running up and down wet slippery ladders to inspect the backflushing of ion exchange resins has been eliminated at the Culligan Soft Water Service plant in San Bernardino, Calif., with the installation of a set of Plexiglas tanks.

The tanks, fabricated by Planet Plastics, Inc., from ½-inch clear Plexiglas sheet, offer several advantages over metal tanks. Backwashing of ion exchange resins is a preliminary step to regeneration, and consists of flushing the resins with water to remove impurities. With the acrylic tanks, an operator can detect excessive or insufficient flow rate merely by looking. He also has a convenient visual check on the appearance of the backwash effluent. Further, accident hazards are reduced, since it is no longer necessary to climb metal ladders to the top of the tanks.

Plexiglas sheet is supplied by Rohm & Haas Co.



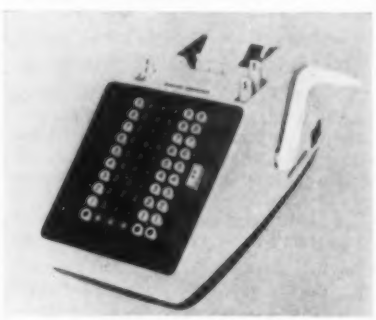
Backflushing tanks in regeneration plant.

Readers' Service Item 50

Molded Adding Machine Parts

Both the bases and cases of Smith-Corona Marchant's five new adding machines are molded from plastic. Auburn Plastics, Inc., injection molded the case of high impact polystyrene and the base of ABS copolymer for strength, stability, and low gloss finish. The molded bases and tops are reported to fit perfectly and provide closer tolerances than could be obtained from parts mass produced from many other materials. Tooling for the molds was done by Auburn.

Physical characteristics of the materials are expected to appeal to the consumer. The plastic is resistant to staining; the finish is permanent: it will not fade or corrode. Further, the machines can be cleaned with soap and water. They can take extreme stress without chipping, cracking, or scratching. Special cushioning and close tolerances eliminate machine rattle.



Smith-Corona adding machine.

Readers' Service Item 51

Copper Clad Laminates

Plastic Products Division of International Resistance Co. is producing a varied line of copper clad laminates in lengths up to 100 feet. Currently available is one or two ounce copper bonded to 5-mil Kel-F, 5-mil Teflon-FEP, 7-mil Teflon-glass cloth, 5-mil linear polyethylene, and 6-mil Mylar. Laminates as thin as one ounce copper bonded to 1-mil Teflon or Mylar have also been manufactured.

Readers' Service Item 52

When the problem is inorganic pigments and extenders for compounding plastics...

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Today Williams offers a complete line of inorganic pigments and extenders for the plastics industry. All have color permanence and chemical stability. Here is a representative list of these products.

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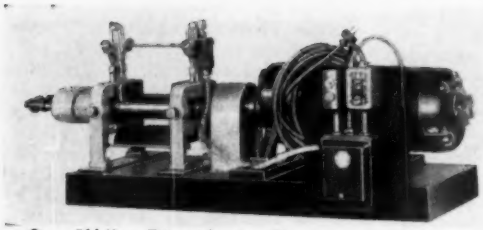

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No. 8, 22" and 26" diameter rolls.

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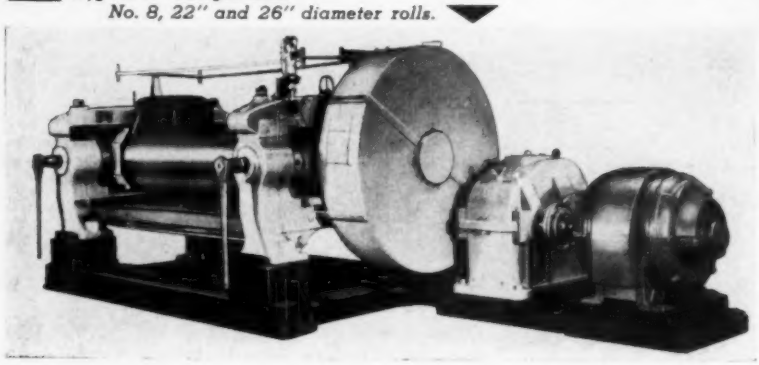
AND
DOWN...



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Speed Reducers • Gears • Extruders

Rainbow glasses

Plastic Cocktail Glasses

In line with the trend of products for outdoor living, Rainbow Plastic Products, Inc., is molding plastic cocktail glasses for use in pool and patio areas. They are molded of Zerlon, methyl methacrylate-styrene copolymer made by Dow Chemical Co., which, according to Dow, will not be discolored or cracked by alcohol.

Distributed by Allied Buyer Corp., the glasses stand 4½ inches high, and hold a standard 4½-ounce measure of liquid.

Readers' Service Item 53

Cruiser Components

In addition to molding boats of fiberglass-reinforced polyester, Richardson Boat division of United Marine, Inc., has begun to replace wood and steel cruiser components with plastic ones. One of the newest is a white, sturdy, shelter top for Richardson's 31-foot express cruisers and custom utility boats. The top, 9½ feet long and 8½ feet wide, consists of a mahogany and plywood skeleton covered with a reinforced plastic skin. The hardtop, ¼ inch thick, is made by hand layup from Hetron 32-A, supplied by Durez Plastics division, Hooker Chemical Co. The completed top, reinforced with two or three layers of fiberglass, is resin welded to the wooden frame.

Readers' Service Item 54

Chalkboard Surfacing Material

A vinyl chalkboard material, Armorsol, is being baked on the custom line of movable steel partitions for offices and schools produced by Virginia Metal Products, Inc. The finish, formulated by John L. Armitage and Co. from vinyl resins supplied by Union Carbide Plastics Co., becomes an integral part of the partition. It will not screech when chalk is moved across it.

Readers' Service Item 55

New Literature

For more information check Readers' Service Card (p. 115)

"Catalog of Precision Apparatus." Mico Instrument Co. 4 pages. Features of a laboratory polishing lathe, engraver, edging machine, toroid winder, rotary table, and heavy duty pantograph are listed. Uses of the equipment and available accessories are mentioned.

Readers' Service Item 61

"The Story of Alkyd Resins." Brighton Corp. 50 pages. This pamphlet comprehensively traces the processing of alkyd resins for coatings from the time of their inception up to the finished product, charting all necessary steps and describing materials and processes.

Readers' Service Item 62

"Wittek Clamps." Wittek Manufacturing Co. 16 pages. Illustrations and condensed information on clamps for hose, flexible plastic pipe, ducts, and general industrial applications is featured.

Readers' Service Item 63

"PVP Formulary." Booklet No. AP-98. Antara Chemicals, General Aniline & Film Corp. 22 pages. This guide to products incorporating polyvinylpyrrolidone contains formulations for over 30 products, including adhesive and coatings. Characteristics of PVP as applied to each end use, are noted in a series of prefaces.

Readers' Service Item 64

"Research in Plastics." Bulletin 158. CTL Division, Studebaker-Packard Corp. 8 pages. Research and development work with reinforced plastics for such items as structural members, re-entry vehicles, and insulation is briefly introduced.

Readers' Service Item 65

"Engineering Guide to the Forms, Properties, and Applications for Dow Corning Silicones." Dow Corning Corp. 16 pages. Available as fluids, lubricants, resins and adhesives, dielectrics, and Silastic rubber, silicones are noted for their indifference to environment. The brochure serves as a catalog of silicone products by applications.

Readers' Service Item 66

"Catalog 605." Syntron Co. 68 pages. A condensed catalog of vibratory materials handling equipment, vibrating parts handling equipment, power rectification equipment, mechanical shaft seals, paper joggers, and portable power tools. Descriptions, data, and specifications of all Syntron products.

Readers' Service Item 67

"Banc-Lok: The Modern Fastener." Boots Corp. 8 pages. Specifications and application information on self-locking inserts and tapped holes is presented. Cross section application drawing indicates the features of each and advantages in plastics.

Readers' Service Item 68

"Lorco and Techline Equipment." Bulletin No. 1002. Lord Chemical Co. 6 pages. Photographs and explanatory text cover vibratory and barrel finishing equipment; wet blast equipment, media, compounds, and abrasives; and auxiliary finishing equipment.

Readers' Service Item 69

"Processing Merlon Polycarbonate Resin by Extrusion." TIB No. 47-M3. Mobay Products Co. 4 pages. Material preparation, equipment, extrusion conditions, operating suggestions, coloring, and suggested applications of extruded forms are covered.

Readers' Service Item 70

"Engineering Data Chart." Comco Plastics, Inc. 4 pages. Principal grades and properties of thermosetting laminated materials, with illustrations of component parts and sub-assemblies.

Readers' Service Item 71

"Urethane Coatings for Wood." Bostik Technical Bulletin #3-60. B. B. Chemical Co. 3 pages. Two urethane resins systems, offered as clear coatings for wood, are reported to produce highly durable, protective finishes that enhance the beauty and character of the grain.

Readers' Service Item 72

"Laminated Plastic Parts — Make or Buy?" Synthane Corp. 8 pages. Eight reasons for using the company's services for fabricating industrial thermosetting laminates are given.

Readers' Service Item 73

"Scott Testers." Scott Testers, Inc. 92 pages. A catalog with illustrations, verbal descriptions, and specifications of testers, dials, Tensilgrams, clamps, dies, and drives.

Readers' Service Item 74

"4-Vinyl-1-Cyclohexene." Texas-U.S. Chemical Co. 32 pages. Physical properties, chemistry, preparation, polymerization, and uses of VCH and its reaction products are explained. Prepared by a Diels-Alder condensation of butadiene with itself, VCH can yield commercially useful resins, adhesives, and plasticizers. A special section is devoted to epoxide derivatives, which reduce the viscosity of heat-resistant epoxy resins.

Readers' Service Item 75

"Automatic Single Spindle Rotary Spraying Machine." Conforming Matrix Corp. 2 pages. A spray finishing machine with vertical traveling guns, Model SS2-GVT, is also available with mask washer and spray booth. This air-operated equipment may be used on cylindrical and rectangular parts.

Readers' Service Item 76

"New Dimensions in Nameplate Design." W. H. Brady Co. 4 pages. Aimed at product designers, this brochure details Poly-Plate self-bonding, metallized Mylar nameplates. Specifications and applications are included.

Readers' Service Item 77

"Extrusion Coating Today." Union Carbide Plastics Co. 8 pages. A review of current developments in polyethylene extrusion coating presented by F. R. Tittman at a recent ACS meeting. New resin compounds, fabricating innovations, and future markets are discussed.

Readers' Service Item 78

"Fiberglas Industrial Fabric Newsletter." Owens-Corning Corp. 2 pages. The first issue of this quarterly newsletter, published last spring, contains market and product notes on woven Fiberglas.

Readers' Service Item 79

"Coatings Selector." Bee Chemical Co. 8 pages. Three charts show the uses and characteristics of the company's spray, dip, and flow coating materials; vacuum metallizing coatings; and standard plastisol formulations.

Readers' Service Item 80

"ASP Mineral Extenders for Urethane Foams." TI-260. Minerals & Chemicals Corp. of America. 8 pages. The resin portion of all types of foams, including prepolymer flexible foams, one-shot flexible foams, and quasi-prepolymer and one-shot rigid foams, can be extended by adding aluminum silicate extenders to the ingredients before foaming. The bulletin includes formulae, property comparisons, and test data.

Readers' Service Item 81

New Literature (Cont'd.)

"Color Matching Skylights." Macbeth Daylighting Corp. 2 pages. For accurate critical color matching and mixing of dyes, as well as maintaining effective color control during production, the company recommends its skylights and fixtures.

Readers' Service Item 82

"Sturtevant Dry Processing Equipment." Sturtevant Mill Co. 8 pages. Photographs, flowsheets, tables, and graphs present information on air separators, mixers, grinders, milling machines, screens, and other laboratory and production equipment.

Readers' Service Item 83

"Air Conveying Systems." Flo-Tronics, Inc. 4 pages. Describes the variations possible in the engineering of air conveying systems for the bulk handling of powdered and granular materials. Illustrated with diagrams showing typical equipment and systems arrangements.

Readers' Service Item 84

"Materials for Fibrous Glass Reinforced Plastics." Catalog No. 2. Cadillac Plastic and Chemical Co. 16 pages. The catalog lists specifications and prices of all types of Fiberglas reinforcements, PVA film, epoxy and polyester resins, and miscellaneous supplies for fabrication.

Readers' Service Item 85

"Catalog No. 60." Custom Scientific Instruments, Inc. 16 pages. Seventy-seven testers, and other equipment manufactured as standard products, are illustrated and briefly described. Custom building services are stressed.

Readers' Service Item 86

"101 Ideas in High Density Polyethylene." W. R. Grace & Co., Polymer Chemicals Div. 20 pages. The range of potential applications of high density polyethylene is illustrated by photographs of 101 commercially successful products. Among items featured in the section on design considerations are section thickness, fillet radii, ribs, and bosses.

Readers' Service Item 87

"Conax Safetywells." Bulletin 360. Conax Corp. 4 pages. Illustrations, descriptions, and specifications of what are claimed to be the first safetywells combining safety and fast response.

Readers' Service Item 88

"Hollesters." Holloway Sucro-Chemicals Corp. 2 pages. Insolubilizer-plasticizer materials for polyvinyl alcohol and polyvinyl acetate are liquid, modified and stabilized sugar esters and derivatives. They reportedly have excellent color and heat stability, and will cause polyvinyl alcohol film to withstand boiling water for 20 minutes without any permanent change.

Readers' Service Item 89

"Our BIPEL Preform Rate jumped from 1900 to 3300 per hour!"
So reports General Industries Co., Elyria, Ohio . . . on their new BIPEL Horizontal Hydraulic Preformers. Leading producers everywhere are praising these faster, more flexible units. Are you getting maximum results? Write for complete information.
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"Micro-Indentation Testers." Testing Machines, Inc. 4 brochures, 18 pages. Model H5 will measure hardness of small or irregularly shaped rubber and plastic parts. A second model can be used for rigid plastics and for measuring the state of cure of polyesters, while the third tests hardness of thin surface coatings.

Readers' Service Item 90

"Albert Torsion Tear Tester." Bulletin 265. Thwing-Albert Instrument Co. 2 pages. The instrument measures shear strength or tearing resistance of strongly directional materials which usually tear at right angles to the direction of greatest strength. The bulletin describes the instrument, method of operation, and typical applications.

Readers' Service Item 91

"Neoprene Adhesive F-1." Carboline Co. 2 pages. Recommended for bonding metals, structural materials, and many plastics. Specifications, characteristics, and directions for application are provided.

Readers' Service Item 92

"Press Equipment for Pressure Processing." Bulletin 6000. Hydraulic Press Manufacturing Co. 16 pages. Among plastic molding machines manufactured are conventional and preplasticizing injection machines and compression, transfer, reinforced plastic, and melamine dinnerware presses. Hydraulic components, dieing machines, and die casting machines are also discussed and illustrated.

Readers' Service Item 93

"Brochure." Ernest F. Fullam, Inc. 16 pages. Consultant in industrial development, control, and research, the company specializes in electron, X-ray, and light microscopy.

Readers' Service Item 94

"Immersible Transducers." Ultrasonic Corp. 2 pages. End fitting transducers offered by this firm are equipped with flexible immersible cable to permit maximum freedom of placement within the cleaning tank. The bulkhead type is designed for permanent mounting by means of a single hole.

Readers' Service Item 95

"Sawology." Nicholson File Co. 34 pages. Designed for the purchasing agent, shop superintendent, production foreman, and mechanic, this treatise discusses the selection and use of hacksaw and band saw blades for cutting hard plastics.

Readers' Service Item 96

"Sun Prestige 740-A EP Lubricant." Sun Oil Co. 1 page. Recommended for general industrial use, the lubricant, unlike stiff greases, is suitable for small-line centralized lubrication systems.

Readers' Service Item 97

Book Reviews

"Plastics Engineering Handbook." Third Edition. The Society of the Plastics Industry, Inc. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Cloth, 7¼ by 10¼ inches, 565 pages. Price, $15.00.

The first edition of this handbook, published in 1947, was accepted as the most authoritative and useful source of information on the plastics industry. Since that time it has kept pace with new developments. In 1954, a second edition was published and now, a third, revised and expanded, is presented in a larger, double column format.

The subject matter is presented in 26 chapters. The first, "Nomenclature," is new. Considering the immense number of new words that the plastics industry has contributed to the language, this chapter might well become the authority for commonly used industrial words.

Each section has been screened to remove out-of-date material. Widely accepted and improved methods, standards, and charts appear. Chapters two through six augment the information on compression molding in the earlier editions. They include the latest techniques, materials, and machinery used by compression molders. Chapter seven is a readable, up-to-the-minute summary of injection molding. However, since the machinery used in this process often combines a screw for preplasticizing the resin, it might have been placed next to chapter nine on extrusion. Between the two is "Preforming, Drying, and Preheating," which comprehensively describes briquetting and preheating of thermosets. Heating and drying of thermoplastics is less adequately covered. Sharper division between discussion of the techniques might have made reading easier for the uninitiated. It would also have helped clarify the differences in treating the two materials.

"Extrusion and Extrusion Machines" has been radically revised to include the latest information on film, sheet, and laminating methods. It covers in general terms blow molding, wire covering, and extrusion/injection molding.

Although photos of pressure forming equipment appear, no discussion of this process is included in the section on thermoforming.

A new feature is a treatise on foamed and expanded cellular plastics.

The section on casting, although revised, supplies little on its own that is new to the art. The reader should keep in mind that casting and embedding and potting (the last two are discussed in a later chapter) are interrelated, relying largely on the same techniques. Therefore, the two chapters comprise a unit.

Included in the discussion on mold design and dies are "T" dies used in sheet and film extrusion, a blowing die for expanded tubing production, a die for pipe extrusion, and a crosshead die for wire covering extrusion. Extrusion has been expanded with a description of hot runner type molds and cooling arrangements. Many of the designs show the adaptation of torroid type, "O" ring packing, used for sealing off mold compartments. Electroforming of molds, a process which has displaced hobbing in some specialized applications, is also included.

Discussion of metallizing is limited to the batch process. Yet, continuous metallizing, used to coat plastic film and other continuous substrates, has shown more rapid growth in recent years than the former. New to the chapter on machining, finishing, and decorating, is a description of the du Pont spin welding technique, illustrated with drawings of the end configurations. This is a method of sealing rigid and semi-rigid thermoplastic containers by the heat of friction.

In general, this is a valuable reference for the plastics engineer, patent attorney, and others interested in the fundamental principles of plastics processing. Most of the shortcomings are slight. As in many compilations, written by several specialists, some chapters are excellent and others leave something to be desired.

"Tensile Properties for Three Thermoplastics over Six Decades of Rate." R. E. Ely, Redstone Arsenal, U. S. Army Ordnance Corp. PB 151573, OTS, U. S. Department of Commerce, Washington 25, D. C. 75 pages. Price, $2.00.

Tensile properties for ethyl cellulose and polymethyl methacrylate are reported for testing machine crosshead velocities of 0.02 to over 5,000 in./min. Polyethylene data are given for a slightly smaller range of velocities. Fracture times varied from a few milliseconds to hundreds of minutes. Other data include brittle points, ultimate strains, and elastic moduli.

"Impact and Shock Resistance of Plastics: Final Report." North Carolina State College for Bureau of Ships, U. S. Navy. PB 151729, OTS, U. S. Department of Commerce, Washington 25, D. C. 35 pages. Price $1.25.

Placing plastics under a tensile impact load can yield valuable information about impact resistance. A very stable, pendulum-type impact tester, The Raleigh-Edwards-Tensile - Impact - Machine - Pendulum, or RETIMP, was developed to deliver enough energy to fracture notch-free specimens of relatively large diameter. RETIMP can be used at numerous energy and velocity levels, facilitating investigation of impact resistance as a function of these two variables. Specimens of various sizes can be tested to determine relationships between specimen size and impact resistance.

"High Density Foam-in-Place Band for Prefabricated Panels." J. M. Schramp, Rome Air Development Center, U. S. Air Force. PB 151628, OTS, U. S. Department of Commerce, Washington 25, D. C. 16 pages. Price, $.50.

It is reported that lightweight, foam-in-place edge bands of self-expanding polyurethane are structurally stronger and have lower thermal conductivity than various woods used as edging. Further, gaskets and fasteners can be molded into place. The dense edge provides a good vapor barrier; edge designs can be varied; and a good bond can be obtained between the core and edging, and edging and facing material. Other advantages not common to conventional sandwich panel edge bands are listed.

"ASTM Proceedings, Volume 59, 1959." American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Cloth, 6¼ by 9¼ inches, 1412 pages. Price, $12.00.

This record of 1959's technical accomplishments includes reports, papers, and discussions offered to the society during the year. It includes a summary of the ASTM 62nd annual meeting, June 1959, and the third Pacific area national meeting, September 1959, listing by title and author the programs for each session.

Seventy-one reports from technical committees, with appendices, and 44 technical papers and discussions provide information on research and standards. The discussions following the papers have not previously been published.

The Board of Directors has reported on administrative, technical, and financial matters.

"Resins—Rubbers—Plastics Yearbook 1959." Edited by H. Mark, E. S. Proskauer, and V. J. Frilette. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. Cloth, 6¾ by 9¾ inches, 1568 pages. Price, $60.00.

International in scope, this volume is a compilation of abstracts on the polymerization and mechanism of organic reactions in rubber and plastic resins. Because of coverage and format, it is a valuable reference.

Each abstract is headed with a brief statement of subject. Information on authors, location at which research was done, publication, title, purpose, experimental work, results, and discussion follows. In most cases, the abstracts are relatively complete, containing original data, charts, graphs, photographs, etc.

Article Abstracts

Materials

"X-Crepe Paper as Reinforcing Material" V. E. Calvin, PLASTICS INDUSTRY, 18, 7, 18 (July 1960).

This material can be used as a reinforcement in laminates, as well as in thermoformable laminates.

"Specific Heat of Polypropylene," H. Wilski, KUNSTSTOFFE, 50, 6, 335 (June 1960).

The mean specific heat and enthalopy of isotactic polypropylene at 20° C. were determined in the temperature range of 0-300° C.

"The Problem of Non-toxicity of Plastics for Packaging Foodstuffs," P. Ghersa, MATERIE PLASTICHE 25, 8, 663 (Aug. 1959); and POLIPLASTI 7, 34, 12 (July-Aug. 1959).

While high polymers used in food-packaging are non-toxic in themselves, the migration or extraction of additives may have undesirable effects on the human system under certain conditions. The author reviews that legislation has been enacted in the United States, Western Germany, Britain, and France, and lists the resins and additives considered non-toxic in the respective countries. (In Italian.)

"Studies on Polyester Amides," K. Thinius, W. Brov, and K. H. Wingerter, PLASTE U. KAUTSCHUK, 6, 8, 372 (Aug. 1959).

Bis-oxyethylamides and bis-oxypropylamides were prepared from homologous aliphatic dicarboxylic acids and terephthalic acid, which subsequently underwent polycondensation. Polyester amides from sebacic acid and propanolamine or its higher homologs proved promising technically. Polyester amides also were prepared from mixtures of aliphatic dicarboxylic acids and terephthalic acids. (In German.)

"Proposal for Determining a Quality Coefficient for Thermoplastic Sheet." A. Scipioni and G. Giaretta, MATERIE PLASTICHE, 25, 8, 679 (Aug. 1959).

The authors propose the determination of a coefficient of quality for thermoplastic sheet and explain the method of its calculation, its importance in considering the suitability of sheet for specific purposes, and its usefulness in solving technological problems. (In Italian.)

"A New Test for Polyethylene Printability—The Inclined Platform Tester," T. F. McLaughlin, Jr., SPE J., 16, 7, 710 (July 1960).

Description of method and machine for the Chapman Test for printability of polyethylene films.

"Montivel—New Plastics Film," E. Ferrari, MATERIE PLASTICHE, 25, 7, 587 (July 1959).

Montivel is the Mylar-type film (polyethylene terephthalate) now produced in Italy by the Montecatini concern. Properties and applications are described. (In Italian.)

"Plasticizer Studies II. Findings in Producing the Higher Esters of Acetoacetic Acids and their Use as Plasticizers," K. Thinius and W. Schwarz, PLASTE U. KAUTSCHUK, 6, 8, 383 (Aug. 1959).

The tests were carried out primarily to develop plasticizers for PVC which would yield exceptionally cold-resistant compounds. The preparation of acetoacetic esters and their alcoholysis with polyhydric alcohols are described. The products of the alcoholysis showed little compatibility with PVC, but under specified conditions, a few reacted favorably with cellulose triacetate. (In German.)

"The Measurement of Exotherm Characteristics and their Application in Epoxide Resin Casting Systems," G. R. Edwards, BRIT. PLASTICS, 33, 5, 203 (May 1960).

A new method of expressing the reactivity of casting resin systems based on epoxide resins with amine curing agents is presented. The major advantage of the new method, as compared with the usual gel-time determinations, is that the property used as a measure of reactivity is a fundamental property of the system.

"Investigations on the Mechanical Chemical Degradation of Polystyrene by Grinding in a Vibration Mill," H. Grohn and K. Bischof, PLASTE U. KAUTSCHUK, 6, 8, 361 (Aug. 1959).

By the investigations described, it could be determined qualitatively that macroradicals are obtained by subjecting Polystyrene BW to mechanical-chemical degradation by grinding in a vibration mill. A product of Chemische Werke Buna, Schkopau, polystyrene BW is a thermal block polymer of average molecular weight 160,000-180,000 and a K value of 68. Mechanical chemistry opens up new perspectives in the application of macroradicals as initiators of polymerization and as active reagents in the production of new types of block copolymers and graft polymers by reaction with monomers, as well as with macroradicals of other polymeric materials. (In German.)

"Internally Plasticized PVC—A Contribution toward the Problem of Impact-Resistant PVC," W. Ebersbach and K. H. Michl, KUNSTSTOFFE, 49, 10, 513 (Oct. 1959).

Internally-plasticized PVC resins, combining excellent mechanical properties with easy processibility, have been developed by suspension polymerization of a mixture of monomers. Properties, proccessing methods, and applications are described for the three grades now available. (In German.)

"Plasticizer Studies. I. Production of Oligomer Polyacrylates and their Suitability as Plasticizers." K. Thinius and W. T. Hummler, PLASTE U. KAUTSCHUK 6, 7, 314 (July 1959).

Starting from a survey of known methods of producing low-polymer compounds, the polymerization is described of the homologous series of n-acrylacrylates up to C_8 as well as of beta-chloroethyl and tetrahydrofurfuryl acrylates, both by the ionic chain and radical chain mechanisms. The influence was examined of mercapto compounds on the properties of polymerizates produced in high-boiling solvents with radical-forming catalysts. The low molecular products were tested as plasticizers for PVC, and their solvent action and film-forming characteristics with PVC studied in relation to molecule size and configuration. (In German.)

"Effect on Bond Strength of Fillers in Adhesives for Metals," H. Schlegel and W. Seyffarth, PLASTE U. KAUTSCHUK 6, 8 368 (Aug. 1959).

A variety of fillers (including ground quartz, porcelain or glass; graphite, ebonite dust; iron, aluminum, and zinc powders; iron oxide; and aluminum oxide) were mixed with epoxy adhesives to test the effects on bond strength to steel, magnesium/aluminum alloy, and pure aluminum. Under certain conditions, cold-curing epoxy resins combined with suitable fillers gave improved bond strength with light metals, but no improvement seems to have been noted with steel. Loading is considered advantageous because it helps to stretch adhesives, while surfaces to be united need not be perfectly even. (In German.)

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines is printed here quarterly.

The next complete listing will appear in October. The last listing appeared in the July issue.

"High Duty, Light-Weight Constructional Elements Made from Glass Fiber Reinforced Resins," U. Hutter, KUNSTSTOFFE, 50, 6, 318 (June 1960).

After dealing with the mechanical properties of glass-reinforced plastics, a process is described whereby it is possible to control the introduction of the lines of force in highly-stressed constructional elements. Airscrews for helicopters and spring elements made by this process are discussed.

"General Formula for Creep and Rupture Stresses in Plastics," S. Goldfein, MODERN PLASTICS, 37, 8, 127 (April 1960).

A formula for calculating these data is presented.

"Measuring Low Temperature Brittleness of Plasticized PVC," A. Coen and P. Parrini, MATERIE PLASTICHE, 25, 5, 357 (May 1959).

After discussing methods and apparatus for measuring cold brittleness of plasticized PVC, the authors briefly describe their own experiments by the ASTM D746 and the Clash-Berg methods. (In Italian.)

"Tensile Shear Strength of Epoxy Resin-Metal Bonds," K. Buser, PLASTE U. KAUTSCHUK, 6, 4, 184 (April 1959).

In connection with the loss of strength of epoxy-metal bonds, the VEB. Leuna Werke, East Germany, reports tests carried out to test welds for which the firm's Epilox products were used. Results seem to indicate that the thickness of the seam is a factor. (In German.)

"Testing Impact Strength of Plastics Moldings," W. Woebcken, KUNSTSTOFFE, 49, 9, 435, (Sept. 1959).

In the VDE rules for testing mechanical strength of housings, particularly plastics housings for electrical instruments and components, the use of a drop-hammer type of impact tester is specified. On the basis of past experience, a modified, electrically controlled drop-hammer device was designed, and a testing method is proposed by which impact strength can be determined at any point of the plastics molding. (In German.)

"Significance of Oxirane and Iodine Values in Epoxy Plasticizers," J. Fath, MODERN PLASTICS, 37, 8, 15 (April 1960).

These values are shown to be important in calculating by-products to be obtained.

"Measurement of Environmental Stress-Cracking of Polyethylene," A. Rudin and A. M. Birks, ASTM BULL., No. 245, p.60 (April 1960).

Discussion of a proposed test method and the results provided.

"Weathering Resistance of Plasticized PVC. Compounds for Cables and Wires," W. Birnthaler and G. Falk, KUNSTSTOFFE, 49, 9, 439 (Sept. 1959).

Plasticized PVC sheets were exposed to natural weathering over a period of eight years and the resulting embrittlement evaluated mainly by means of the very sensitive cold impact test. The influence of the individual compounding ingredients could be determined, and it was shown that weathering effects can be reduced to a minimum chiefly by proper selection of plasticizers, as well as of pigments (carbon black being best). (German.)

"Impact-Resistant PVC Granulates," G. Wick and H. Konig, KUNSTSTOFFE, 49, 10, 506 (Oct. 1959).

Results are reported on Vestolit, the Huls unplasticized PVC, modified with varying percentages of an elastomer in order to improve its notched impact strength, especially in cold, while taking into account good processibility, good aging, and economy. Electrical, physical and chemical properties of the various modified products and possible applications are dealt with. (In German.)

"Determination of Average Call Volume in Foamed Products," R. H. Harding, MODERN PLASTICS, 37, 10, 156 (June 1960).

A simple method for measuring open cell content and average cell volume is described.

"Some Special Test Methods Applicable to Polyethylene," D. Weston, PLASTICS (London). 24, 265, 465 (Nov. 1959).

The methods dealt with include specific gravity measurements based on the suspension of a sample in a methylated spirit/water mixture; evaluation of grades at injection molding shear rates; measurement of yield strength, tensile strength, ultimate elongation and tensile impact strength; the rigidity modulus test by the Maxwell needle method; measuring coefficient of friction of packaging film; static tests for sheet or injection moldings and lay flat film, using an Oertling aperiodic balance; optical tests; and moisture vapor transmission test for film.

"Permeability of Chlorotrifluoroethylene Polymers," A. W. Myers, V. Tammella, V. Stannett, and M. Szwarc, MODERN PLASTICS, 37, 10, 139 (June 1960).

The results of an investigation with gases and vapors are given.

"Cellular PVC Sandwich Structures," H. Lindemann, KUNSTSTOFFE, 50, 6,-331 (June 1960).

This article deals with rigid, lightweight, constructional elements consisting of a core of rigid cellular PVC faced on both sides with glass-polyester. Their behavior when subjected to impact stress is shown by means of comparative tests.

"Stereoregular Polymers," D. C. Blackley, APPLIED PLASTICS, 3, 5, 20 (May 1960). A discussion of where we stand in synthesizing these polymers (ethylenes, polypropylenes).

"How to Predict Structural Behavior of RP Laminates," Lawrence Fischer, MODERN PLASTICS, 37, 10, 120 (June 1960).

A mathematical approach to the subject is presented.

"Measurement of the Brittleness Temperature of Polyethylene," A. M. Birks and A. Rudin, ASTM Bull., 246, 49 (May 1960).

A proposed test method is presented for discussion.

"High Temperature Plastics: Where Do We Stand?" W. Brenner, MATERIALS DESIGN ENG., 51, 6, 132 (June 1960.)

An assessment of progress in developing polymers for long-time service at 500° F. and higher.

"Properties of High Density Polyethylene," Patrick Moxey, APPLIED PLASTICS, 3, 5, 32 (May 1960).

The properties of Rigidex high-density polyethylene are described.

"The Blow Molding of Cellulosic Plastics," D. A. Jones and R. J. Haughwout, SPE J., 16, 6, 633 (June 1960).

A review of cellulose acetate and cellulose propionate for blow molding, with mention of equipment requirements, processing techniques, and post-finishing.

"The Use of Extenders in Flexible Urethane Foams," T. H. Ferrigno, SPE J., 16, 6, 638 (June 1960).

The use of aluminum and magnesium silicate and calcium carbonate extenders is discussed.

"Isophthalic Polyester Resins," R. E. Park, SPE J., 16, 6, 641 (June 1960).

A brief discussion of these resins and their potential fields of application.

"Calculation of Polyamide-Epoxy Fairing Compounds for Automobiles," D. E. Feerman and D. E. Floyd, SPE J., 26, 7,-717 (July 1960).

Organic solders (fairing compounds) that can be used in automobiles.

"Long-Term Stress Resistance of Resin/-Glass Laminates in Different Environments," J. J. Millane, BRIT. PLASTICS, 33, 5, 199 (May 1960).

The flexural strengths of laminates bonded with different resins and tested under varying environments are compared. The effect of water on long-term strength is particularly noticeable when glass fiber is the filler. Suggestions are made to counteract this behavior.

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Equipment

"Inserts and Fasteners," J. H. DuBois, PLASTICS WORLD, 18, 7, 20 (July 1960).

A brief review of types of inserts and fasteners.

"Twin-Nozzle Spray Gun for Polyesters," J. Coudenhove, PLASTVERARBEITER, 10, 8, 298 (Aug 1959).

The author describes the Austrian apparatus and method used in a low-pressure spraying process for impregnating fiberglass mats and cloth with polyester resin for use in the construction of busses, rail coaches, and special vehicles, as milk trucks and the like. The resin/catalyst and resin/accelerator compounds, which are in two separate containers in a single pressure tank, pass to a twin-nozzle spray gun by two separate hoses, mingling only at a certain angle as they stream from the respective nozzles, just before hitting the surface to be treated. (In German.)

"Injection Molding Tool for Small Wheels," H. Gastrow, KUNSTSTOFFE, 50, 3, 197 (March 1960).

Discussion of an actual mold and its construction.

"Plastificator with Attached Screw," M. Doriat, KUNSTSTOFFE, 49, 9, 489 (Sept. 1959).

The efficiency of the Werner & Pfleiderer Plastificator (Wacker System) has been increased further by connecting with it a screw by which gelation and granulation is possible in one operation. The plastificator-screw combination also may be used as a drying machine for moist material, for instance polyvinyl acetate bead polymer. (In German.)

"Reciprocating Screw Injection Machine," J. G. Fuller, MODERN PLASTICS, 37, 8, 110 (April 1960).

Report on experiences of a U. S. Molder with one of these new machines.

"Liquefaction of Thermoplastics—New Melt Process for Extrusion and Preplasticization in Injection Molding," T. Engel, KUNSTSTOFFE, 49, 8, 408 (Aug. 1959).

The Engel Extruder described is a machine of simple design in which granulated material is delivered to a rotating, indirectly heated disk from which the resulting melt is taken up by the screw conveyor. (In German.)

"Large Injection Molding Machine with Built-in Pre-plasticization." E. Witt, KUNSTSTOFFE, 49, 10, 546 (Oct. 1959).

Detailed description of a HPM-type machine built in Germany with a shot capacity of 13¼ pounds, and designed with built-in preplasticization. (In German.)

Applications

"ABS Polymers for Pipe and Pipe Fittings," R. L. H. Damerham, APPLIED PLASTICS, 3, 7, 34 (July 1960).
A brief review of current applications.

"The Use of Terylene Polyester Fiber in Reinforced Plastics," W. Glen and B. A. Green. RUBBER & PLASTICS AGE, 40, 5, 439 (May 1960).
Uses of the reinforced plastic in structural applications either alone or in overlays for a glass reinforcement are given.

"Adhesives and Sealers," J. C. Middleton, SPE J., 16, 6, 644 (June 1960).
How epoxy-based adhesives permit high production rates.

"Plastics in the Printing Industry," Peter Balwin, APPLIED PLASTICS, 3, 5, 26 (May 1960).
A generalized review of applications for plastics.

"Plastics in Motor Vehicles," M. Parducci, MATERIE PLASTICHE, 25, 7, 625 (July 1959).
In 1958, Italy had a total of some 3,500,000 motor cycles, motor scooters, and small motorized delivery vans, including in their construction a wide variety of small and large parts and accessories made from phenolics, acrylics, PVC, polystyrene, polyamide cellulosics and even polypropylene. The author presents applications in Italian vehicles, as well as in some British and German vehicles. (In Italian.)

General

"Norwegian Plastics Exports and Imports," D. Schwabe-Hansen. RUBBER & PLASTICS AGE, 41, 6, 650 (June 1960).
A brief review of 1959 statistics.

"Swiss Industries Fair—1960," V. Wolpert, RUBBER & PLASTICS AGE, 41, 6, 661 (June 1960).
A short report on the Fair.

"Production of Precision Plastic Sheeting," Peter Siegel, RUBBER & PLASTICS AGE, 41, 6, 646 (June 1960).
A brief note on factors affecting the sheeting machinery.

"Plastics in the Far East," A. Renfrew, RUBBER & PLASTICS AGE, 41, 6, 639 (June 1960).
Review of statistics on Japan, Hong Kong, and Malaya.

"Britain's Plastics and Rubber Export Prospects," W. Altman, RUBBER & PLASTICS AGE, 41, 6, 636 (June 1960).
The current position of the E. F. T. A. market.

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Patent Digest

Materials

Composition Comprising Methyl Methacrylate Polymer, Nitrocellulose, Reaction Product of a Bisphenol and a Dicarboxylic Acid and Solvent, Process for Preparing Same and Article Coated Therewith. No. 2,907,722. D. N. Staicopoulos, Drexel Hill, Pa. (to E. I. du Pont de Nemours and Co., Wilmington, Del.).

Stabilization of Perfluorochloroolefin. No. 2,907,742. H. H. Frey and R. Huth, Frankfurt am Main, Germany (to Farbwerke Hoechst AG vormals Meister Lucius & Bruning, Frankfurt am Main, Germany).

Manufacture of Polymethylene Terephthalate in the Absence of a Catalyst. No. 2,907,753. D. Maclean, N. Standring, P. V. Youle, and N. Munroe, Harrogate, England (to Imperial Chemical Industries, Ltd., London, England).

Modified Melamine Laminating Resins. No. 2,908,603. M. J. Scott, Lexington, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

Polyepoxide Polyalkylene Glycol-Anhydride Compositions and Processes for Their Preparation. No. 2,908,660. W. J. Belanger, Louisville, Ky. (to Devoe & Reynolds Co., Inc.).

Vinyl Resin Emulsions Containing Methoxy Polyethylene Glycol. No. 2,910,448. A. I. Goldberg, Berkeley Heights, and K. V. Jasinski, N. Plainfield, N. J. (to National Starch Products, Inc., New York, N. Y.).

Polyvinyl Chloride and Poly Alkyl Tin Mercaptosuccinates. No. 2,910,452. M. J. L. Crauland, Paris, France (to Societe Anonyme des Manufactures des Glaces et Produits Chimiques de St.-Gobain, Chauny & Cirez, Paris, France).

Graft Copolymers Prepared from Unsaturated Polyvinyl Chloride and Acrylic Esters and Method of Making Same. No. 2,908,662. R. W. Rees, Shawinigan Falls, Quebec, Canada (to Shawinigan Chemicals Ltd., Montreal, Quebec, Canada).

Process of Dispersing Pigments or Resins in Polystyrene Using Boric Acid. No. 2,910,450. D. A. Popielski, Springfield, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Prices, 25c each.
—The Editor

Mouldable Materials. No. 2,910,456. P. A. J. K. de Gooreynd, Tillington, Petworth, and L. J. Saxxy, Teddington, England (to Peterlite Products, Ltd., London, England).

Mixture of Trifluorochloroethylene Reaction Products Useful as Potting and Sealing Compositions. No. 2,909,503. W. S. Barnhart, Cranford, N. J., C. K. Travis, Riverdale, N. Y., and C. R. Leder, Princeton, N. J. (to Minnesota Mining and Manufacturing Co., St. Paul, Minn.).

Continuous Process for the Production of High Molecular Weight Olefin Polymers. No. 2,910,461. G. Nowlin, Glen Burnie, Md., and H. D. Lyons, Bartlesville, Okla. (to Phillips Petroleum Co).

Ethyl Cellulose Compositions. No. 2,911,315. J. H. Fookes, Hope, and R. A. Nutter, Shepherd, Mich. (to Dow Chemical Co., Midland, Mich.).

Process of Making Extruded Styrene Polymer Foams. No. 2,911,382. R. A. Barkhuff, Jr., E. Longmeadow, and N. Platzer, Springfield, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

Reaction Products of Polyepoxides and Monomeric Partial Esters of Polyhydric Alcohols with Maleic Anhydride-Unsaturated Organic Acid Adducts, and Methods and Compositions for Producing the Same. No. 2,909,496. H. G. Cooke, Jr., and J. E. Masters, Louisville, Ky. (to Devoe & Reynolds Co., Inc., Louisville, Ky.).

Vinylidene Chloride Copolymer Coating Compositions. No. 2,909,449. T. F. Banigan, Kenmore, N. Y. (to E. I. duPont de Nemours & Co., Wilmington, Del.).

Process of Making Polyethylene Film Receptive to Organic Coating. No. 2,909,443. L. E. Wolinski, Buffalo, N. Y. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Polymerization of Acrylonitrile-Alpha Methyl Styrene Mixtures Onto Polybutadiene and Products Produced Thereby. No. 2,908,661. W. C. Calvert, Gary, Ind. (to Borg-Warner Corp., Chicago, Ill.).

Vinyl Chloride Compositions Containing Alkyl-1,5-Pentanediol Polylesters. No. 2,909,499. R. I. Hoaglin, S. Charleston, W. J. Reid, Charleston, and R. G. Kelso, St. Albans, W. Va. (to Union Carbide Corp.).

Homogeneous Polyethylene. No. 2,910,460. R. S. Aries, New York, N. Y.

Copolyamide of 4-Aminomethyl-Cyclohexyl Carboxylic Acid. No. 2,910,457. S. C. Temin, Cleveland, and M. Levine, Cleveland Heights, O. (to Industrial Rayon Corp., Cleveland, O.).

Polyvinyl Chloride Plasticized with Adducts of Long Chain Olefinic Acid Amides and Fumaric Acid Esters. No. 2,913,431. J. Dazzi, Dayton, O. (to Monsanto Chemical Co., St. Louis, Mo.).

Vinyl Resin Plastisol Containing Plasticizer and Boron Ester. No. 2,912,400. H. M. Olson, Hudson, O.

Vinyl Chloride-Vinyl Acetate Copolymer Dissolved in Solvent Mixture Containing Aromatic Hydrocarbon and Lactone Component. No. 2,913,430. G. P. Roeser, Lahaska, Pa. (to American-Marietta Co., Stoner-Mudge Co. Div., Chicago, Ill.).

Dyeing Plastic and Solution Therefor. No. 2,914,373. R. G. Rieser, New Kensington, Pa. (to Pittsburgh Plate Glass Co., Allegheny County, Pa.).

Non-Electrostatic Styrene Polymer Compositions. No. 2,912,413. M. Baer, Springfield, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

Chlorosulfonated Polyethylene Composition. No. 2,914,496. D. J. Kelly, Wilmington, Del. (E. I. du Pont de Nemours and Co., Wilmington, Del.).

Stabilized Ethyl Cellulose Compositions. No. 2,914,416. R. A. DeLap, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Resins from Epoxidized Polymers and Polyhydric Alcohols. No. 2,914,490. C. E. Wheelock, Bartlesville, Okla. (to Phillips Petroleum Co.).

Bonding Polytetrafluoroethylene Resins. No. 2,914,438. B. W. Sandt and P. J. Wayne, Wilmington, Del. (to E. I. du Pont de Nemours and Co., Wilmington, Del.).

Aqueous Dispersion of Vinyl Chloride Polymer Containing Substituted Polyacrylamide. No. 2,914,498. R. W. Quarles and W. H. McKnight, Pittsburgh, Pa. (to Union Carbide Corp.).

Patent Digest (Cont'd.)

Polyamides. No. 2,909,566. A. J. Speziale, Kirkwood, Mo. (to Monsanto Chemical Co., St. Louis, Mo.).

Epoxide-Anhydride-Hydroxy Polymer Compositions and Method of Making Same. No. 2,908,663. J. E. Masters, Louisville, Ky. (to Devoe & Reynolds Co., Inc.).

Modified Epoxide Resins. No. 2,908,-664. W. J. Belanger, J. E. Masters, and D. D. Hicks, Louisville, Ky. (to Devoe & Reynolds Co., Inc.).

Light Stable Haloethylene Polymer Compositions. No. 2,910,453. D. A. Gordon, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Polyvinyl Chloride Plastic Compositions Containing an Organophosphorus Amide as an Ultraviolet Inhibitor. No. 2,912,411. J. W. Tamblyn and H. W. Coover, Jr., Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

Process of Preparing a Cured Blend of Form-Stable, Cross-Linked Polyethylene and Polybutadiene and Compositions Thereof. No. 2,912,410. Q. P. Cole, Pittsfield, Mass. (to General Electric Co.).

Resinous Chlorine Containing Polyester, Fire Proof Plastic Therefrom, and Process for Producing Same. No. 2,912,-409. G. Nischk, Leverkusen, and K. E. Muller, Leverkusen-Bayerwerk, Germany (to Mobay Chemical Co., Pittsburgh, Pa., and Farbenfabriken Bayer AG., Leverkusen, Germany).

Vinyl Resin and Clay Composition Stabilized with Lead and Epoxy Compounds. No. 2,912,397. V. J. Houska, Bound Brook, and R. J. Lurie, Plainfield, N. J.

Phosphorus-Containing Polyesters and Method for Their Production. No. 2,913,-436. W. A. Reeves and J. D. Guthrie, New Orleans, La. (to U. S. A.).

Equipment

Machine for Shaping Thermoplastic Sheets. No. 2,912,718. A. Thiel, Mainz-Weisenau, Germany (to Vogt & Hartmann, Mainz-Weisenau, Germany).

Method and Apparatus for Molding Foils. No. 2,911,677. E. Weber, Zurich, Switzerland (to Hydrochemie AG., Zurich, Switzerland).

Molding of Void-Free Olefin Polymers Using Pressure, Vacuum and Directional Cooling. No. 2,911,678. R. J. Brunfeldt, Bartlesville, Okla. (to Phillips Petroleum Co.).

Apparatus for Extruding Plastic Material. No. 2,911,676. G. E. Henning, Baltimore, Md. (to Western Electric Co., Inc., New York, N. Y.).

Mold Structures and Mold Conveying Means. No. 2,912,717. W. W. Yarrison and V. H. Meyer, Beverly, and D. A. Lane, Lynn, Mass. (to United Shoe Machinery Corp., Flemington, N. J.).

Electrically Heated Sprue Bushing for Injection Molding Apparatus. No. 2,911,-680. G. W. Kelly, Columbus, O. (to Columbus Plastic Products, Inc., Columbus, O.).

Injection Molding Machine and Control Mechanism Therefor. No. 2,912,719. G. D. Gilmore, Rochester, and J. Decker, Birmingham, Migh. (to Bopp-Decker Plastics, Inc., Clawson, Mich.).

Apparatus for Stretching Plastic Sheet Material. No. 2,912,716. C. R. Frownfelter, Pittsburgh, Pa. and R. J. Harry, Cincinnati, R. S. Hassard, Cuyahoga Falls, and D. C. Shearer, Tallmadge, O. (to Goodyear Aircraft Corp., Akron, O.).

Plastic Molding Machine. No. 2,913,762. E. R. Knowles, Fairfield, Conn. (to Specialty Papers Co., Dayton, O.).

Apparatus for Preventing Bag and Sag in Oriented Plastic Film. No. 2,910,961. J. W. McIntire, Midland, and K. G. Francis, Bay City, Mich. (to Dow Chemical Co., Midland, Mich.).

Process and Apparatus for Molding Large Plastic Structures. No. 2,913,036. G. H. Smith, Lawndale, Calif. (to Anthony Bros. Fibre Glass Pool Corp., South Gate, Calif.).

Assembly for Supporting Center Cores in Annular Supply Passageways for Circumferential Extrusion Dies and the Like. No. 2,913,763. M. O. Longstreth and J. E. Tollar, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Plastic Bottle Blowing Apparatus. No. 2,914,799. R. W. Canfield, W. Hartford, Conn. (to Plax · Corp., W. Hartford, Conn.).

Method and Apparatus for Manufacturing Hollow Articles of Thermoplastic Material. No. 2,914,801. R. Colombo, Turin, Italy (to S. A. S. L. M. P. di M. I. Colombo & Co., Turin, Italy).

Extrusion Graining Process. No. 2,-914,807. E. S. Robbins, Killen, Ala. (to Robbins Floor Products, Inc., Tuscumbia, Ala.).

Injection Molding Apparatus. No. 2,-914,840. E. Gaspar and M. G. Munns, London, England (to Projectile and Engineering Co., Ltd., London, England).

Directory

1 time $19.00 per inch
6 times $18.00 per inch
12 times $15.00 per inch

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Mechanical or Chemical Engineer for Injection Molding Technical Service and Development. Desire experience in Mold Design, Material Selection and Injection Molding Techniques and Equipment.
Please send resume, including education, experience, and salary requirements to:
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Profitable Expanding Canadian Manufacturing Company Vinylite Fabrics Related Lines Full Information Write:
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Ovens, Grinders, Powder Mixers, Injection Molding Machines 1 oz. to 60 ozs. never used and used, Two, Three, Four-Head Blow Molding Machines, Extruders, granulators and refrigeration systems.
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Used injection molding machines, ovens, granulators. One machine or complete plant.
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500 Saw Mill River Rd., Yonkers, N.Y. YOnkers 5-0900
102 Grove Street, Worcester, Mass. PLeasant 7-7747

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Unusual opportunity for a top level man, or his assistant, in the expansion program of progressive national company. This man must have heavy experience in injection molded plastics as well as a knowledge of metals and mechanisms. Toy experience desirable. He must have ability to take a program from our designers and stylists and gear it for mass production as well as coordinate closely with industrial designers, tool designers, and manufacturing staff. Submit resume stating experience, previous earnings, etc. All replies will be held in strictest confidence.
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M.S. or Ph.D., recent graduates, for advanced development of special purpose casting resins. Freedom to follow problems of individual interest is encouraged with moderate amounts of time being spent in consultation with design engineers concerning the proper utilization of materials in specific designs. Prove-in of new materials involves construction of laboratory prototypes, follow-up on pilot-plant runs and some production trouble shooting. Complete analytical chemical, physical testing, and electrical measurements laboratories are available to support the individual in these efforts.

Sandia Corporation, located in Albuquerque, N.M., is engaged in research and development of nuclear weapons and other projects for the AEC. Albuquerque is a modern city of about 225,000; has an excellent climate and many cultural and recreational attractions. Winters are mild, summer nights are cool, and there's plenty of year-around sunshine. Liberal employee benefits include generous vacations, retirement and insurance plans and an educational assistance program. Paid relocation allowance.

Mail resume in complete confidence to: Professional Employment Section 598.

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Plastic Co. wishes to diversify and set up separate expandable Polystyrene operation in N. J. Interested in man qualified to take full charge of operation, must be fully capable of setting up new plant, handling personnel, mold design, quality and production control, and purchasing. Exceptional opportunity for right man. All replies held in strict confidence. Submit resume to:

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HELP WANTED MALE
Chemist

For research on new polymers and coating materials derived from them. Experience with either vinyl or condensation polymerizations is needed. Knowledge of flame retardant coating would be helpful. Opportunity is at Grand Island Research Center between Niagara Falls and Buffalo in Western New York. Send resume and salary requirement to:

A. V. Thorpe
Supervisor of Technical Placement
Hooker Chemical Corp.
Niagara Falls, New York

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Experienced in epoxy casting, molding resins and techniques. Progressive company in Southwest Virginia, adding separate molding division and expanding present usage. Resumes treated confidentially. State present and expected salary. Reply:

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630 Third Avenue New York 17, N.Y.

Current Market Prices

Plasticizers		
Eastman dibutyl phthalate	lb.	$0.285 / $0.325
Diethyl phthalate	lb.	.265 / .305
Di-isobutyl phthalate	lb.	.27 / .31
Di-(2-ethyl hexyl) isophthalate	lb.	.28 / .32
Di-(2-ethyl hexyl phthalate	lb.	.26 / .30
Plasticizer 84	lb.	.255 / .295
FMC di-iso-decyl phthalate	lb.	.265 / .305
Dinopol IDO	lb.	.265 / .305
Dioctyl phthalate, DIOP	lb.	.26 / .30
KP-261	lb.	.46 / .475
Methox	lb.	.39 / .425
Ohopex Q-10	lb.	.275 / .315

Resins and Molding Compounds		
Polyamide		
Allied Chemical Plaskon nylon 6	lb.	.98 / 1.15
Vinyl		
Marvinol VR-10, -12, -22, -23, -24, -25, -26, -31, -33	lb.	.23 / .43
-50, -51, -53	lb.	.255 / .455
-60	lb.	.245 / .445
Solvents		
Enjay acetone	lb.	.08 / .12
Methyl ethyl ketone	lb.	.125 / .165

CALENDAR of COMING EVENTS

September 22
SPE Binghamton Section RETEC. Plastics in Business Machines. Sheraton Inn, Binghamton, N.Y.

September 26-30
Instrument Society of America. Sixteenth Annual Conference and Exhibit. Coliseum, New York, N.Y.

September 27-29
Technical Association of the Pulp and Paper Industry. Eleventh Annual Testing Conference. Pantlind Hotel, Grand Rapids, Mich.

October 5
SPE Golden Gate Section RETEC. Plastics vs. Corrosion. Mark Hopkins Hotel, San Francisco, Calif.

October 6-7
National Association of Corrosion Engineers. Regional Meeting. Sheraton-Palace Hotel, San Francisco, Calif.

October 9-12
ASME Rubber and Plastics Conference. Lawrence Hotel, Erie, Pa.

October 13-14
SPE Sixteenth Annual New England Section Conference. Wentworth-by-the-Sea, Portsmouth, N. H.

October 14-23
French Packaging Institute. First International Packaging Machinery Show. Autopac 1960. Paris, France.

October 17-19
Technical Association of the Pulp and Paper Industry. Fifteenth Plastics-Paper Conference. Hotel Syracuse, N. Y.

October 17-19
International Congress, 1960, on the Technology of Plastics Processing. Royal Institute for the Tropics, Amsterdam, Holland.

October 19-26
International Plastics Exhibition macroPlastic 1960. Exhibition Grounds, Utrecht, Holland.

October 25-27
American Standards Association. Eleventh National Conference on Standards. Sheraton - Atlantic Hotel, New York, N. Y.

November 7
SPE Ontario Section RETEC. Automation in Injection and Compression Molding. King Edward Sheraton Hotel, Toronto, Ontario, Canada.

November 15-17
National Academy of Sciences-National Research Council, Building Research Institute. 1960 Fall Conferences. Shoreham Hotel, Washington, D. C.

November 18
SPE Newark Section RETEC. Blow Molding Comes of Age. Hotel Essex House, Newark, N. J.

November 22
Manufacturing Chemists' Association. Tenth Semi-Annual Meeting and Midyear Conference. Statler-Hilton Hotel, New York, N. Y.

November 27-December 2
ASME Winter Annual Meeting. Statler-Hilton Hotel, New York, N. Y.

November 30-December 2
U. S. Army Signal Research and Development Laboratory. Ninth Annual Symposium on Technical Progress in Communication Wires and Cables. Berkeley-Carteret Hotel, Asbury Park, N. J.

November 30-December 2
British Plastics Federation. International Reinforced Plastics Conference. Cafe Royal, London, England.

Domestic Production and Sales of Plastics and Resin Material, April and May, 1960

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of April and May, 1960. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

	April, 1960		May, 1960	
	Production	Sales	Production	Sales
Cellulose Plastics:				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,326,225	1,484,559	1,615,973	1,689,227
Sheets, p.003 gage and over	1,498,155	1,702,041	1,801,670	1,827,159
All other sheets, rods, and tubes (including other cellulose plastics)	617,873	890,620	749,267	719,887
Molding and extrusion materials (including other cellulose plastics)	7,466,819	7,906,658	7,493,625	7,139,776
Nitrocellylose sheets, rods, and tubes		121,142	244,630	126,461
TOTAL	10,909,072	12,105,020	11,905,165	11,599,510
Phenolic and Other Tar-Acid Resins:				
Molding materials	18,175,619	16,753,090	18,636,822	15,633,721
Bonding and adhesive resins for—				
Laminating (except plywood)	5,543,346	3,727,147	5,843,180	3,661,715
Coated and bonded abrasives	1,145,094	1,024,622	1,324,644	1,165,366
Friction materials (brake linings, clutch facings, and similar materials)	962,263	1,019,738	921,260	903,193
Thermal insulation (fiber glass, rock wool)	2,768,485	2,979,187	3,076,609	2,932,434
Plywood	4,416,766	3,411,965	3,922,898	3,225,195
All other bonding and adhesive uses	5,863,456	5,624,100	6,100,652	5,572,607
Protective-coating resins unmodified and modified except by rosin	2,361,494	1,889,323	2,722,096	1,835,738
Resins for all other uses	4,264,543	4,013,920	4,024,195	3,261,399
TOTAL	45,501,066	40,193,092	46,572,356	38,191,368
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	2,607,884	2,383,029	2,942,823	2,503,442
Paper-treating and paper-coating resins	2,619,776	2,096,327	2,220,508	2,522,260
Bonding and adhesive resins for—				
Laminating	3,392,566	2,385,153	3,281,862	2,433,589
Plywood	8,637,892	8,040,047	7,784,322	7,615,912
All other bonding and adhesive uses	2,766,105	2,577,335	2,365,756	2,366,863
Protective-coating resins, straight and modified	3,230,629	1,933,971	3,099,800	2,321,961
Resins for all other uses, including molding	10,878,338	10,529,518	10,937,019	9,327,793
TOTAL	34,133,190	29,945,380	32,631,090	29,091,820
Styrene Resins:				
Molding and extrusion materials:				
Straight polystyrene	23,661,082	20,858,730	20,314,635	19,468,850
All other	30,142,332	26,861,808	32,009,773	27,120,311
Protective-coatings	6,101,953	6,173,064	6,043,945	5,919,786
Textile and paper treating and coating resins	5,411,678	4,645,135	6,159,309	4,254,960
All other uses	13,624,447	18,827,680	15,051,985	22,466,455
TOTAL	78,941,492	77,366,417	79,579,647	79,230,362
Vinyl and Vinyl Chloride Resins:				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		8,271,514		7,610,140
Sheeting (resin content)		10,814,839		11,623,220
Molding and extrusion (resin content)		22,834,824		24,220,922
Flooring (resin content)		5,156,850		5,455,892
Protective coating (resin content)		12,811,206		13,103,280
All other uses (resin content)		3,431,385		3,417,175
All other vinyl resins for—				
Adhesives (resin content)		8,482,272		8,193,856
Protective coatings (resin content)		4,796,747		4,881,492
All other uses (resin content)		2,455,298		2,427,751
		10/188,586		10,195,885
TOTAL	98,122,171	89,243,521	97,867,000	91,129,613
Coumarone-Indene and Petroleum Polymer Resins	19,688,931	19,800,166	20,492,816	19,799,401
Polyester Resins:				
For reinforced plastics	13,619,494	11,360,686	13,550,926	11,019,564
For all other uses	2,414,115	1,956,012	1,844,842	1,738,512
TOTAL	16,033,609	13,316,698	15,395,768	12,758,076
Polyethylene Resins:				
For film and sheeting		32,056,509		27,175,201
Molding materials		15,460,051		13,308,988
Extrusion materials		13,363,423		13,207,279
For all other uses		38,393,936		40,837,095
TOTAL	114,018,792	99,273,919	120,158,679[1]	94,528,563[2]
Epoxy Resins:				
For protective coatings		1,530,118		1,742,613
For all other uses		2,742,147		2,741,676
TOTAL	6,581,287	4,272,265	5,722,825	4,484,289
Miscellaneous Synthetic Plastics and Resin Materials, Including Silicone Resins	24,822,391	20,874,036	24,335,813	21,678,997
GRAND TOTALS	448,762,101	406,390,514	454,661,159	402,491,999

[1]14.4% produced by the low-pressure process.
[2]14.8% produced by the low pressure process.
SOURCE: United States Tariff Commission, Chemical Division.

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Another new development using

B.F.Goodrich Chemical *raw materials*

New Push-Button Heating Pads by General Electric have five parts made of Geon shown in inset: (1) inner cover; (2) cordset; (3) T-Connector; (4) tube which contains thermostat; and (5) heater wire insulation. B.F.Goodrich Chemical Company supplies the Geon vinyl.

How heating pads get "most wanted" features from different Geon vinyls

Waterproof. The manufacturer of these heating pads says they "make wet pack applications a cinch." The reason? Their inner cover is made of film extruded of Geon vinyl. It is tough, abrasion-resistant and waterproof.

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Safe. All the wiring inside the heating pad is insulated with still another Geon vinyl. Geon provides excellent dielectric properties and good resistance to abrasion, weathering and heat, as well as being unaffected by corrosion.

Here is an excellent example of the way one manufacturer uses different Geon resins and compounds to improve a product. For more information, write Dept. GL-5, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Geon VINYLS

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

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